THE PROCESS OF

Parboiling and Dryer

BY MILLTEC MACHINERY
“Parboiling and Dryer Systems“ is about what is parboiling? parboiling process and types of parboiling and dryer systems and machines required for parboiling and dryer.

**Parboiling and Dryer Systems**

The rice obtained from milling pretreated paddy is known as parboiled rice whereas rice obtained from milling of untreated paddy is known as raw rice or white rice.

Milling of paddy without any pretreatment is highly susceptible to breakage and loss of minerals and vitamins. To reduce breakage and loss of minerals and vitamins, pretreatment known as parboiling was developed.

Parboiled Rice is one of the most popular rice products in the world and becomes more important not only by the fact of improved nutritional value but also by the improved cooking and processing properties. The three basic steps of parboiling and dryer process are soaking, steaming and drying.

**What is Parboiling?**

The three basic steps of parboiling and dryer process are soaking, steaming and drying. Parboiling or leaching is the partial boiling of food as the first step in cooking. The word parboiling is from the old French 'parboillir' which means to boil thoroughly. Parboiling can also be used for removing poisonous or foul-tasting substances from foodstuffs.

Parboiled rice is the rice that has been partially boiled with the husk. Parboiling involves partial boiling of the paddy before milling in order to increase its nutrition value, to change the texture of cooked rice, and reduce the breakage in milling.

The complete grain of rice is soaked, steamed and dried, then the hull is removed to make parboiled rice. The steaming enables the rice to absorb
nutrients and changes the starch so that it cooks into a firmer, less sticky dish of rice than regular white rice.

**Advantages of parboiling**

- Reduces grain breakage during milling and hence higher head rice recovery.
- Parboiled rice is nutritionally richer than raw rice.
- During cooking there is less loss of solids in the gruel than raw rice.
- Bran from parboiled rice contains 25-30% oil as compared to 15-20% from raw rice.

**Parboiling and dryer process**

Parboiling of paddy is a hydrothermal process in which there is gelatinization of starch. The process of parboiling is carried out in three steps, these steps also make rice easier to process, boost its nutritional profile and change its texture.

- Soaking
- Steaming
- Drying

**Soaking:**

Soaking paddy in water is required to get a moisture content of about 30-40%. When the rice soaked in water, Minerals and nutrients such as sugars and amino acids are absorbed into the starch. Soaking paddy in cold water or
lukewarm water will increase the moisture content. It is the first and foremost parboiling and dryer process involves drenching of the grain. Soaking is carried about 36-48 hours in the soaking tank at the temperature at 20-30 degree Celsius.

- Paddy soaked in the water at 20-30°C will take 18-48 hours to reach 30% moisture.
- During Hot water soaking (60-65°C) the grain absorbs moisture faster and reaches 30%-35% in 4-6 Hours.
- Water temperature and length of soaking tank effect the solubility of substances rice as well as color, smell and taste.
- Hot Soaking keeps the grain at a higher temperature which will reduce the steaming time.
- The moisture content of the paddy increases to about 38%.

The following time-temperature combination is considered optimum for soaking:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Temperature, °C</th>
<th>Time [hours]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water heated to 50°C and allowed to come to ambient temperature</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Water heated to 75°C and allowed to come to ambient temperature</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Maintained at 60°C</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Maintained at 65°C</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Maintained at 70°C</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Maintained at 72°C</td>
<td>3.5</td>
</tr>
<tr>
<td>7</td>
<td>Steam at 0.5 atm. pressure</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Steaming:

Once the drenching part is done, the paddy is ready for steaming. It is a process which requires heating up the grain for making the grain harder. Steaming of paddy is required to achieve partial gelatinization. Generally, saturated steam at a pressure of 1-5 kg/cm² is used for steaming of soaked paddy.

Duration of steaming depends upon quantity of paddy. For small batch, 2-3 min whereas for large batch (6-8 tons), 25-30 min of steaming is required. During steaming the starch in the endosperm of the rice is substantially gelatinized. Steaming temperature exceeds 100°C, the grain color becomes considerably deeper and the grain becomes harder.

Drying:

Paddy is soaked, steamed and then dried. Drying paddy to is to save the moisture content for storage and milling. This may take sun drying or dryer. Drying is intended to reduce the moisture to 12-14 % for safe storage and milling.

Drying of parboiled paddy from 45-50% (db) to 14-16% (db) needs to be done for proper milling and storage. Sun drying of paddy is generally practiced. For uniform drying, it is important that paddy is spread in 2-3 cm thickness layer and stirred at an interval of half hour.

It is also important that paddy is dried in two passes instead of continuous drying. In first pass, paddy moisture content should be brought down to 18-20% and rest in second pass.

• Paddy requires air temperature of up to 100°C during the 1st drying period.
• Moisture reduce to 38%-20%.
• 2nd Period air temperature 75°C.
• Moisture deduction 18%-14%.

Parboiling causes a gelatinization of the starch during the boiling and during cooling the amylase molecules re-associate with each other and form a tightly packed structure. The kernels are harder and appear glassier after the parboiling process.

The parboiling process moves micro nutrients contained in the bran, which is usually removed in the whitening process in the rice mill, to the endosperm.

Parboiled rice is therefore more nutritious than white rice. Parboiling also mends little cracks that might have developed in the endosperm during post-harvest processing and therefore head rice recoveries of parboiled rice are higher. Parboiled rice takes less time to cook and is firmer and less sticky when cooked.
Machines Used in Parboiling and Dryer Process

RAW PADDY DRYER WITH CYCLONIC FURNACE

Raw paddy Dryer
MILLTEC Raw paddy Dryer Advantages

- SS construction of dryer is designed specially to suit all types of paddy.
- Optional furnace designs to suit the use of rice husk, wood or biomass.
- Less husk and power consumption, the cost of drying is reduced by 50% compared to steam drying.
- Though it is fired by husk or wood, smokeless hot air is extracted directly, hence odorless drying is achieved.
- PLC system to monitor and control the temperature, can achieve temperatures up to 160 deg C.
- Two dryers can be connected with single cyclonic husk furnace.
- No boiler requirement and hence lower cost of investment
- Environment friendly, pollution free design.
- Clean smoke less hot air usage for dying application to have odourless grains
- Specially designed to dry harvested paddy up to 30% moisture
- Easy operation and less maintenance.
- Huge husk saving compares to conventional furnace.
- Connect 2/3 drier units with a single cyclonic husk furnace
- High efficiency in combustion produces clean hot air with smokeless, pollution free & environment friendly.

Cyclonic Husk Furnace:
Advantages

High efficiency in combustion produces clean hot air with smokeless, pollution free & environment friendly.

Digital temperature with husk feeding system (Auto Controller)

Husk consumption 1/3 when compare to boiler (150kg/Hr)

No boiler requirement and hence lower cost of investment.

Can connect two dryer units with a single cyclonic husk furnace.

ONLINE COOKER

Advantages

• Uniform color/ Uniform cooking
• Hygienic & easy operation.
• 20% Steam Saving
• No maintenance.
• Consistent quality

Completely automatic continuous cooking system to increase productivity

Suitable for all verities paddy

Uniform Cooking and even Color Rice

Man power not required

Can be easily retrofitted to existing par boiling and drying plants

Less steam requirement

Hygienic Process

Stainless steel construction
FLOUDISED BED DRYER

Advantages

Advanced design for high moisture reduction 7% in single pass.

Uniform drying method

Continuous drying to achieve homogeneous drying

Competitive price and can be easily retrofitted to existing par boiling and drying plants to increase the commercial value of Parboiled Rice.

Save the LSU dryer life

Negligible maintenance

SS Construction
ONLINE MOISTURE REMOVER

Advantages

Reduce surface moisture nearly up to 5% before feeding to LSU dryers (Rapid Moisture & Temperature Reduction System)

Less power consumption (only 5 HP)

Competitive price and easily installed in existing rice mill to increase the commercial value of parboiled rice.

SS Construction

Highly suitable for steam and boiled paddy

Multi-Purpose Dryer [Paddy/Dal/Maize]

Advantages

Low heat grain Dryer

Very minimum power required.

Uniform and efficient method dryer

Easily installed—Required very small space/ No Foundation & No Civil Works Required.

A wide variety choice of fuel- diesel or kerosene

Less Broken / High Productivity / Quality and Hygienic Process
Parboiling of paddy

CFTRI method of parboiling

Parboiling tank is filled with clean water and heated to about 85°C.

Paddy is dumped into hot water in tank for soaking. The temperature of paddy-water mixture comes down to 70°C which is maintained for 3-3.5 h.

After soaking, water is drained from tank and then exposed to steam at a pressure of 4 kg/cm² until husk starts splitting.

Steamed paddy is dried in multiple passes.

During parboiling, the water requirement is about 1.25 times the weight of paddy and requirement of steam is about 200 kg/ton of paddy.

MILLTEC process of parboiling of paddy:

- Soaking is carried out either in cold water (single boiled-partially parboiling) or hot water (Double boiled – Fully translucent kernel without white core).
- Hot water for soaking at 60deg C, reduces the soaking time by 8-10hrs.(Full translucent grain)
- Water is filled into the tanks, paddy is fed from the storage tanks
- The floating chaff is removed from the surface
- In hot water soaking, the water is heated to 80-85deg.C and paddy is fed & water is circulated for 30mins
- The temperature of water attains 60deg.C because of quenching of paddy into the water
- After the completion of soaking(5-6hrs), the paddy moisture is between 32-34%
• Water is drained and steam is passed for a period of 5-10mins. Parboiling occurs and the moisture increases to 35-37%

**MILLTEC process of drying of parboiled paddy:**

<table>
<thead>
<tr>
<th>Types of</th>
<th>Stage I</th>
<th>Hot Air temp: 100°C</th>
<th>3hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stage II</td>
<td>Hot Air temp: 90° C</td>
<td>2hrs</td>
</tr>
<tr>
<td></td>
<td>Stage III</td>
<td>Hot Air temp: 80° C</td>
<td>2hr</td>
</tr>
</tbody>
</table>

Paddy unloading MC: 13 – 12%
Parboiling and Dryer Systems

1. Single stage parboiling and dryer system (For small grain boiled cream color rice)
2. Two stage parboiling and dryer system (For small grain boiled and steam white color rice)
3. Three stage parboiling and dryer system (For long grain rice like Basmati and other long rice)

Typical simple parboiling and dryer system:

Parboiling is a part of gelatinization of starch process and involves packaged boiler, pre-cleaner, holding bins, soaking tank, cooking tanks and column drier. The pre-cleaned paddy is soaked in the tanks to a pre-determined time and then steam is passed to cook the paddy to suit the requirements like single parboiling or double parboiling. Later the uniformly dried paddy is sent for milling.

MILLTEC Typical simple parboiling and dryer system Features & Advantages:

- Complete stainless steel (SS 202) construction for hygiene & longer life
- Automatic controls for special discharge roller arrangement ensures top down delivery.
- Customized designs to suit variety of paddy

Can supply along with Boilers to avoid miss match of steam requirement
Typical Simple Parboiling System

<table>
<thead>
<tr>
<th>Capacities</th>
<th>20 T</th>
<th>24 T</th>
<th>32 T</th>
<th>40 T</th>
<th>48 T</th>
</tr>
</thead>
</table>

MILLTEC Machinery Ltd
Single stage parboiling and dryer system
Two stage parboiling and dryer system

Steam Paddy Drying System:

MILLTEC provides comprehensive package for steaming and drying paddy. The packaged boiler will produce steam by burning either paddy husk or fire wood. Pre cleaned paddy will be steamed in a parboiling plant under controlled parameters and then discharged to LSU type column drier. The high performance drier will then dry the paddy to the desired level for further processing.

MILLTEC Steam Paddy Drying System
Features/Advantages:

- Using LSU drying technology
- Complete stainless steel construction
- Advanced design of the mechanical parts
- Very minimum power requirements
- Fit & run operation
- Compact design - occupies very small space
MILLTEC Parboiling and dryer special features:

- State of art paddy processing plant for boiled, Half Boiled and steamed Paddy.
- Futuristic design and economical- needs minimum power and fuel.
- Hot air technology – Indirect heating for uniform drying.
- Wholly made of stainless steel- non corrosive and non-erosive-maintenance free.
- Stainless steel plant produces hygienic rice global standard.
- On line cookers can be recommended for Parboiled for uniform cooking & color.
- Special System ensures uniform treatment during parboiling
- Most flexible system for choosing different parameters of parboiling according to the input paddy and desired final product properties,
- Influencing of treatment possible by various parameters.
- Automatically control system for easy operation.
- Increased head rice yield during milling
- Simplified hulling process
- Uniform and stable cooking and processing properties
- Reduced stickiness of cooked rice
- Improved nutritional value and extended shelf life
- Reduced requirement on water and energy
- Prevention of dark coloring effects
- No parboiling smell and have good taste
- Better influence to final cooking behavior
- Alternative for cargo rice importing countries.
- Moisture percentage will be reducing between 11 to 14 %
- Increase the length of rice after cooking (It also depends genetic quality of the rice)
- Can be stored for longer period
- Improved process technique for better color

Parboiled rice might sound like it's precooked, but it's not. Instead, it's processed quite differently from other types of rice. The resulting grain is cooked and served just as you would white or brown rice. However, because of the special processing, parboiled rice is a better source of fibre, calcium, potassium and vitamin B-6 than regular white rice.
Carbohydrates

One cup of cooked parboiled rice provides 41 grams of total carbohydrates, or about one-third of the recommended daily intake of 130 grams. The same portion has 1.4 grams of fibre, which supplies 4 percent of men’s and 6 percent of women’s daily fibre. Parboiled rice has double the fibre than you’d get from cooked white rice. It has a low glycaemic score of 38, compared with a high 89 for white rice, notes Harvard Health Publications. A low glycaemic score indicates that the carbohydrates in parboiled rice do not cause a large spike in blood sugar.

B Vitamins

Parboiled rice is especially rich in niacin, providing 4 milligrams, or 23 percent of the recommended daily intake in 1 cup of cooked rice. You’ll also get 19 percent of the daily intake of vitamin B-6. These values are about double the amount you would get from non-enriched white rice. Your body needs B vitamins to metabolize food into energy, but they also fill other roles, such as helping make hormones and neurotransmitters. Vitamin B-6 removes the amino acid homo cysteine from your bloodstream by turning it into other substances. This might help keep your heart healthy; high levels of homo cysteine are associated with an increased risk of cardiovascular disease.

Minerals

One cup of cooked parboiled rice supplies 2 to 3 percent of the recommended daily intake of calcium, iron, magnesium and potassium. You’ll get a slightly bigger boost of zinc, with 1 cup containing 0.58 milligrams of zinc. That amount represents 5 percent of men’s and 7 percent of women’s daily needs. Zinc performs vital roles throughout your body, from forming the structure of proteins to regulating DNA. If you don’t get enough zinc, your immune system becomes impaired; it needs zinc to produce the cells that fight bacteria and infections.

Factors to control the parboiling rice

1. Paddy or raw material parboiled rice, should the white shell or tan shell, clean grain, smooth grain or fungi not found on the grain.
2. To control the water temperature and soaking time. To prevent bad odours and bad color of parboiled rice.
3. Temperature and steaming time to control the appropriate, It should not be too high. It will affect the color of parboiled rice, deform grain and rice too hard on a long process.
4. Drying must be slow and steady. If the heat is too high and fast drying, the Rice more broken.
5. The moisture content of parboiled rice, should not exceed 14 % when stored in a warehouse This is to prevent the destruction of Microorganisms, especially fungi.

**Compare parboiled rice and plain rice**

1. Parboiled rice is easy to peel off.
2. Parboiled rice spend more time to milling.
3. Parboiled rice milling quality is better than.
4. Parboiled rice storage for longer than.
5. Chalky kernels when parboiling the chalkiness is lost.
6. Parboiled rice with vitamin B1 and vitamin E is higher than.
7. Parboiled rice takes longer to cook.
8. Parboiled rice when cooking is fluffy rice than.
9. Parboiled rice is easy to digestible.
10. Parboiled rice had Rice bran oil is 25-30% but plain rice with only 15-20%.
For more information on MILLTEC parboiling and dryer systems please Contact Us @ 1800 102 8431

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Yield Management System
Silica Extraction
Co – Generation Plants
Whitening & Polishing
Sorting & Grading Plants

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Packaged Boiler
Parboiling & Dryer
Raw Paddy Dryer
Dal Dryer
Pre Cleaner
Flow Balancer / Measurer
De Stoner
Pneumatic Sheller
Tray Separator
Thickness Grader
Water Jet Polisher
Pearler / Polisher
Rotary Sifter
Length Grader
Color Sorter
Packing Machine

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