BROWN RICE MACHINE
Rice Technology Bulletin Series

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Brown Rice (BR) or unpolished rice is now finding its way in today’s Filipino diet, particularly among the high- to middle- income groups. BR awareness and consumption among Filipinos are said to have notably heightened since the official launching of the national BR campaign in 2004 in celebration of the International Year of Rice.

Mindful of the increasing consumer interest in natural and healthy foods, PhilRice is pushing for increased use of BR in the Philippines through the use of its newly developed Brown Rice Machine as a product of modifying the existing rice mill to produce BR that is acceptable and desirable in the market.

With the BR machine, problems on BR’s storage and high price could be addressed.

We hope this bulletin will guide the intended users and our partners in promoting this promising technology. We acknowledge the College of Engineering and Agro-industrial Technology of the University of the Philippines-Los Banos (CEAT-UPLB) for its support during the initial stage of the machine development.

We also recognize the initiatives and contributions of Dr. Eulito U. Bautista and Mr. Harvey Valdez in the realization of this technology.
INTRODUCTION

Brown rice is milled but unpolished rice - a kind of whole, natural grain, coated with bran. Any rice, traditional or improved, hybrid or inbred, long or short grain, may be milled, cooked, and eaten as brown rice. Unpolished rice has high amounts of nutrients, such as vitamin B complex, minerals, protein, fiber, and other phytochemicals.

Regular eating of brown rice can help reduce the incidence of chronic diseases, such as cancer and cardiovascular diseases. Various studies show that brown rice has an advantage of 10% milling recovery compared with white rice.

If every Filipino will eat brown rice at least three times a day or 36 meals a year, our rice importation would shrink by an average of 50,000 mt/yr because of its higher milling recovery.

Traditionally, BR was produced using mortar and pestle. This process can be found in isolated and remote areas, mostly in the third world countries.

PhilRice has developed brown rice machine with promising output. The machine is composed of dehulling unit with 6” rubber rollers, hull aspirator or suction blower, and 1-layer paddy separator. The machine has promising dehulling-separation capacities of 290 kg/hr. Quality of brown rice produced has 99.5% purity.

WHY DEVELOP A BROWN RICE MACHINE?

- High cost of commercial brown rice in the market;
- Milling recovery is 10% higher than white rice;
- Traditional milling is laborious;
- Investment cost is 40% lesser; and
- Power requirement of the system is 50% lower
RICE MILLING PROCESS

NORMAL MULTI-PASS RICE MILL PROCESS

CLEANING
DE-STONING
DE-HUSKING
PADDY SEPARATION
WHITENING 1
WHITENING 2
WHITENING 3
SIFTING
BLENDING
POLISHING
BAGGING

BROWN RICE MACHINE PROCESS

CLEANING
DE-STONING
DE-HUSKING
PADDY SEPARATION
BAGGING
DE-HUSKING
PADDY SEPARATION
BAGGING
OUTSTANDING FEATURES OF THE BROWN RICE MACHINE

- Processes dry paddy to produce quality BR product with less grain breakage
- Separates BR from the unhulled paddy
- Has higher milling recovery of about 10% compared with white rice
- Easy to operate and maintain
- Requires only 2 persons to operate
- Parts are locally available, and can be repaired at local machine shops
- Can process residual paddy into white rice
- Simultaneously recirculates the middling for reprocessing or re-dehulling
- Has a compact design
PRINCIPLES OF OPERATION

1. Brown rice machine’s main components are dehulling unit and paddy separator.

2. The input paddy is loaded into the hopper of the dehulling unit manually or by using bucket elevator. The dehulling unit of the brown rice machine is a pair of rubber rollers. Rotating in opposite direction, the rollers strip off the hull from the grain. One rubber roll moves faster than the other.

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<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>BRM 6D MODEL</th>
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<tbody>
<tr>
<td>Dehulling unit</td>
<td>6” diameter rubber roller</td>
</tr>
<tr>
<td>Dehulling/Separating capacity</td>
<td>290kg/h</td>
</tr>
<tr>
<td>Milling recovery</td>
<td>73%</td>
</tr>
<tr>
<td>Purity of product</td>
<td>98.50%</td>
</tr>
<tr>
<td>Power source</td>
<td>10kW 3-phase, 220V electric motor; 15Hp diesel engine</td>
</tr>
<tr>
<td>Paddy separator</td>
<td>Tray type; 1 or 2 layer/s</td>
</tr>
<tr>
<td>Separator tray dimensions (LxW)</td>
<td>1.200m x 0.400m</td>
</tr>
<tr>
<td>Oscillation speed of paddy separator</td>
<td>300-350rpm</td>
</tr>
<tr>
<td>Bucket elevator</td>
<td>1t/h capacity (w/ 1Hp 1-phase electric motor)</td>
</tr>
<tr>
<td>Loading of input paddy and recirculation of middling</td>
<td>Using bucket elevator</td>
</tr>
<tr>
<td>Overall dimensions (LxWxH)</td>
<td>2.750m x 1.785m x 3.750m</td>
</tr>
<tr>
<td>Labor requirement</td>
<td>2 persons: 1 operator, 1 bagger</td>
</tr>
</tbody>
</table>
3. The product of dehulling process is called middling or a mixture of brown rice, unhulled paddy, hull, and other foreign materials.

4. The middling then passes on the suction blower wherein hull and foreign materials are separated.

5. The middling is then diverted to the paddy separator. The paddy separator separates the BR from the unhulled paddy.

6. Paddy separator works on the differences in specific gravity, buoyancy, and size between paddy and BR.

7. The separation is accomplished by shaking the middling sideways at a certain speed. The product of the separator has three categories: BR (main product), middling, and unhulled paddy.

8. Both middling and unhulled paddy are reprocessed in the unit using the conveyor for redehulling and separation.

**REMINdERS BEFORE OPERATiON**

1. **Check the prime mover.**

   If using electric motor, then check the voltage requirement and plug the machine to the outlet of the specified voltage and phase requirement.

   Be sure that the power cord is free from damage. When using diesel engine, check if there is enough fuel.

2. **Check the belt tensions.**

   Properly adjust the belt tension using the belt tensioner. Undertensioned or loose belts may cause slippage, frictional burning, and other irreparable damages. Overtensioned or tight belts stretch excessively. The desired belt deflection is $\frac{1}{64}$" for every 1” of belt span.

   Be sure to turn off the prime mover during adjustments of belt tensions.

3. **Check the collecting bucket.**

4. **Increase the rubber roll gap to avoid sudden load to the prime mover.**

5. **Clean the loading hopper and bucket elevator to avoid impurities especially when processing pigmented rice or colored rice.**
MACHINE OR DEHULLING OPERATION

1. Turn on the electric motor of the bucket elevator and start loading into the hopper of the dehulling unit.
2. When the hopper of the dehulling unit is full, start the prime mover. Press the green color button on the panel board to start the electric motor. In the case of diesel engine with electric starter, insert the key and hold the decompression lever. Turn the key to activate the starter. Release the decompression lever to start the engine.

3. Set the feed adjuster at the desired position based on the feed adjuster dial and gauge. Pull the shutter to open the hopper and allow passage of paddy to the rubber roll.
4. Gradually adjust the rubber roll gap by turning the gap adjuster knob clockwise. Dehulled sample should be around 85-90% brown rice.
5. Gradually adjust the divider to the desired position. Better results or higher percentage of brown rice may be achieved with 5-10 cm distance from the right facing the separator tray.

6. Put the product in appropriate storage bags. Use recommended storage facility to avoid pest damage and prolong the product’s shelf life (hermetic storage or SACLOB).

**AFTER DEHULLING OPERATION**

- Be sure to turn off the prime mover.
- Clean the dehulling machine and its surroundings.
- Lubricate all the rotating, such as bearings, pillow block, and brushing parts.
- Repair or change damaged parts.
- In case of long interval between operations, remove the belts and store in clean dry place.
- Cover the machine if necessary to protect it from dust and dirt.
# ECONOMIC ANALYSIS OF BROWN RICE MACHINE

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<th>PARAMETERS</th>
<th>BRM - 6D MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment (P)</td>
<td>350,000</td>
</tr>
<tr>
<td>Processing cost (P/kg)</td>
<td>2.20</td>
</tr>
<tr>
<td>Custom rate of dehulling paddy (P/kg)</td>
<td>3.60</td>
</tr>
<tr>
<td>Net income derived (P/kg)</td>
<td>2.20 (2.40)</td>
</tr>
<tr>
<td>Net benefit derived (P)</td>
<td>201,600</td>
</tr>
<tr>
<td>Payback period (yr)</td>
<td>1.8</td>
</tr>
<tr>
<td>Breakeven point (kg)</td>
<td>144,000</td>
</tr>
<tr>
<td>Benefit cost ratio</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Assumptions:** Dehulling-separating capacity 290kg/h utilization of 2-season/yr @ 8h/day, custom rate of milling (ACEF- P 1.80 dehulling & P 1.80 separation); useful life of 8 years, 5% salvage value, 10% repair and maintenance, 12% interest on investment, labor requirement of 2 persons, P300/day, P13/kwh cost of electricity.
REFERENCES


Van RUITEN, H. TH. L. 1979. Village-type Rice Milling Units: A paper written for the University of Agriculture (IPB), Bogor, Indonesia, for its Graduate Course (M.Sc.) in Rice Post harvest Processing Technology titled “MEP 515 – Post harvest Engineering”.

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We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologies so farmers can produce enough rice for all Filipinos. We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 58 agencies and 70 seed centers strategically located nationwide. To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-sufficiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology. We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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