



Parboiling in Thailand and the World



- What is parboiling – introduction
- History
- Relevance in the different cultures
- Markets - Facts and figures
- Process
 - Preparation – parboiling – drying – milling – co-products
- Outlook - discussion

THE PARBOILING PROCESS

- The terms “thermal processing”, “gelatinization” or “parboiling” define the operations needed for the production of “gelatinized” or “parboiled” rice. The “raw” cereal undergoes these operations before hulling.
- Water and heat are two essential elements to transform the natural cereal into “parboiled” cereal.
- After soaking in water, followed by steam heating, the product has to be dried for mechanical processing (milling).
- The purpose of hydrothermal or parboiling processing is to generate physical, chemical and organoleptic changes with corresponding financial, nutritional and practical advantages:

The main changes occurring to the grain structure are the following:

- The water-soluble substances (vitamins and mineral salts) are dissolved and spread inside the endosperm, enriching their original distribution and concentration;
- The crystalline structure, characteristic of the rice starch grain is transformed in an homogeneous and compact mass made of gelatinized starch;
- The starch grains, due to soaking effect, inflate and expand in order to fill any space surrounding them with consequent elimination of cracks existing in endosperm;
- The cereal moisture content is taken to the optimal level regardless of the moisture content before the process;
- Enzymes present are partially or totally inactivated;
- Oily soluble substance, contained in the germ and in the bran layers, are enriched, as other components are dissolved
- All unwanted processes, both latent and ongoing (germination, proliferation of molds or spores, eggs, grubs, pupas, adult insects), are completely inactivated or eliminated.

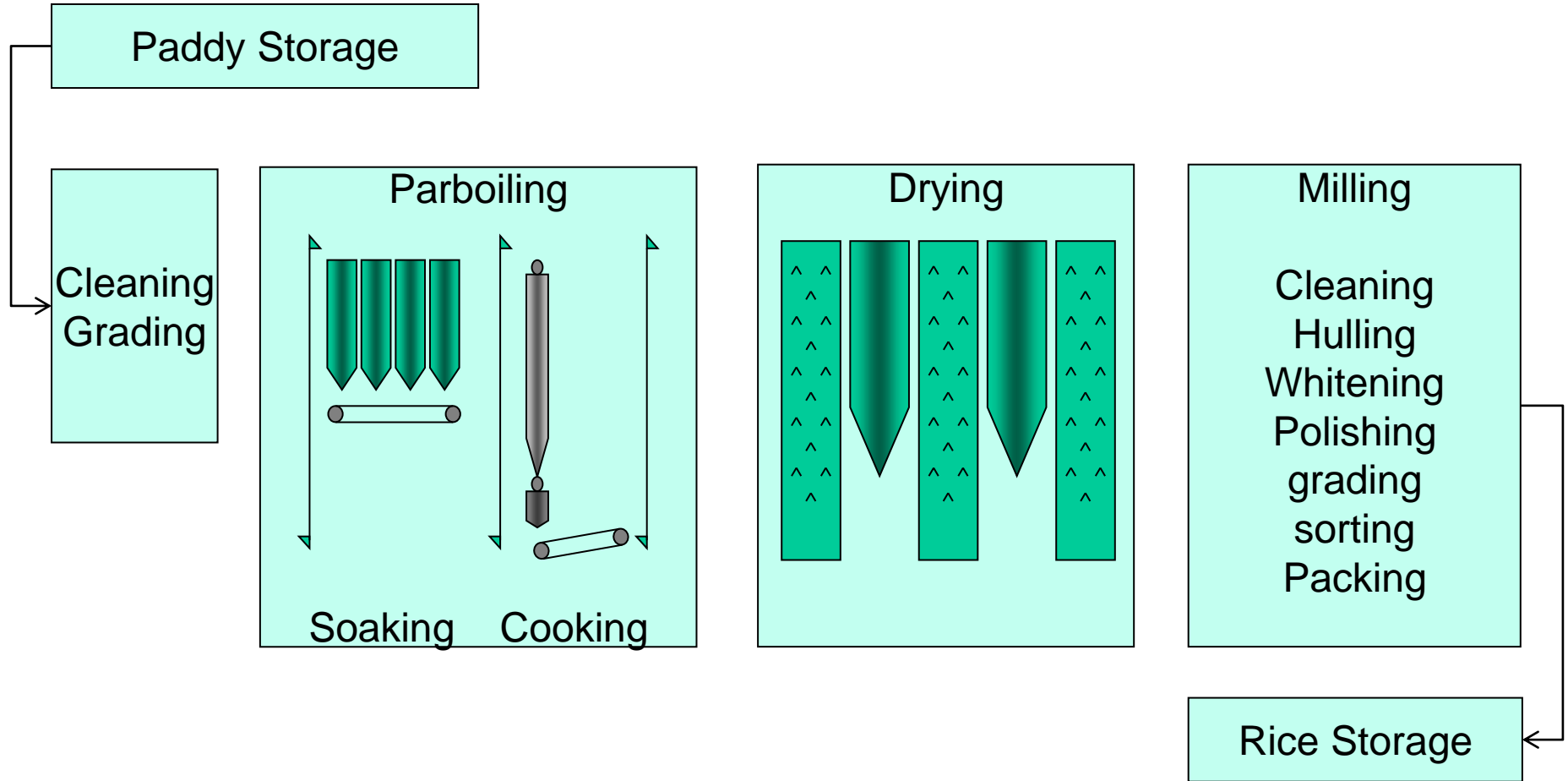
The main consequences for the producer

- The kernel is much harder and allows much less breakage during the milling process
- The hardness makes the kernels more resistant to infestation during storage
- The bran has a higher oil content which makes handling more difficult
- The bran is partially stabilized giving it a better shelf life

and the consumer are:

- Cooking is much easier, as the rice can be kept long time in the pot, a big advantage in the catering industry
- The less knowledgeable house wives (and men) in Northern Europe and North America can easily prepare a good granular rice on the plate.

Parboiling - Introduction



- More than 1000 years ago parboiling was done in simple clay pots in the earth to improve „shelf life“ and the resistance against insects.
- Only in this century parboiling has been developed from a farm or village activity to an industrial process.
- Franco Gariboldi from Italy has experimented in his own rice mill and invented several processes to gelatinize rice.
- He was active in promoting his technology as advisor to the FAO.
- The technology was then picked up by various engineering companies in the USA, Germany, India and others.

- Franco Gariboldi died in 1995.
- Today Gariboldi's assistant engineer and scholar, Mr. Salvatore Appiani carries forward the know how and builds parboiling plants with his company STA Studio Technico Appiani with his world leading technology.
- The technology in Thailand is quite simple and restricts the success of the Thai parboilers on their international export market. *The technical differences will be discussed in the chapter „processes“*

Parboiling – Relevance in the different cultures

- Parboiled rice is not part of the East and South East Asian cuisine. It is not suitable and not appreciated in the „chop stick countries“
- Parboiled rice is appreciated in India and Pakistan for it's good storage properties and special taste

Parboiling – Relevance in the different cultures

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- It is also appreciated in North America and Europe for easy cooking properties and low breakage in the milling process.
 - Catering services can keep parboiled rice hot for a long time without damage to the rice.
 - Private households prefer the simple cooking instructions



So einfach geht es ...

1



Ausreichend
Wasser zum
Kochen bringen.

2



Den Kochbeutel
ca. 20 Minuten
köcheln lassen.

3



Beutel an der
Lasche aus dem
Wasser nehmen.

4



An der
Einkerbung
aufreißen.

5



Umdrehen und
ausleeren.

Parboiling – Relevance in the different cultures

- African countries have adopted parboiled rice in their local recipes because of the good storage properties reducing the storage losses
- The Gulf countries have developed a high end market of parboiled Basmati rice.



Qualities of parboiled rice

- Statistics
 - rice production
 - Consumption
 - trade
- Share of Parboiled rice in the consuming countries
 - USA
 - EU
 - South America
 - India, Pakistan
 - Nigeria

- Type and quality of raw product
 - Long grain
 - Basmati rice
 - Medium grain parboiled
- Colour:
 - Crystal white parboiled
 - Medium yellow
 - Golden parboiled

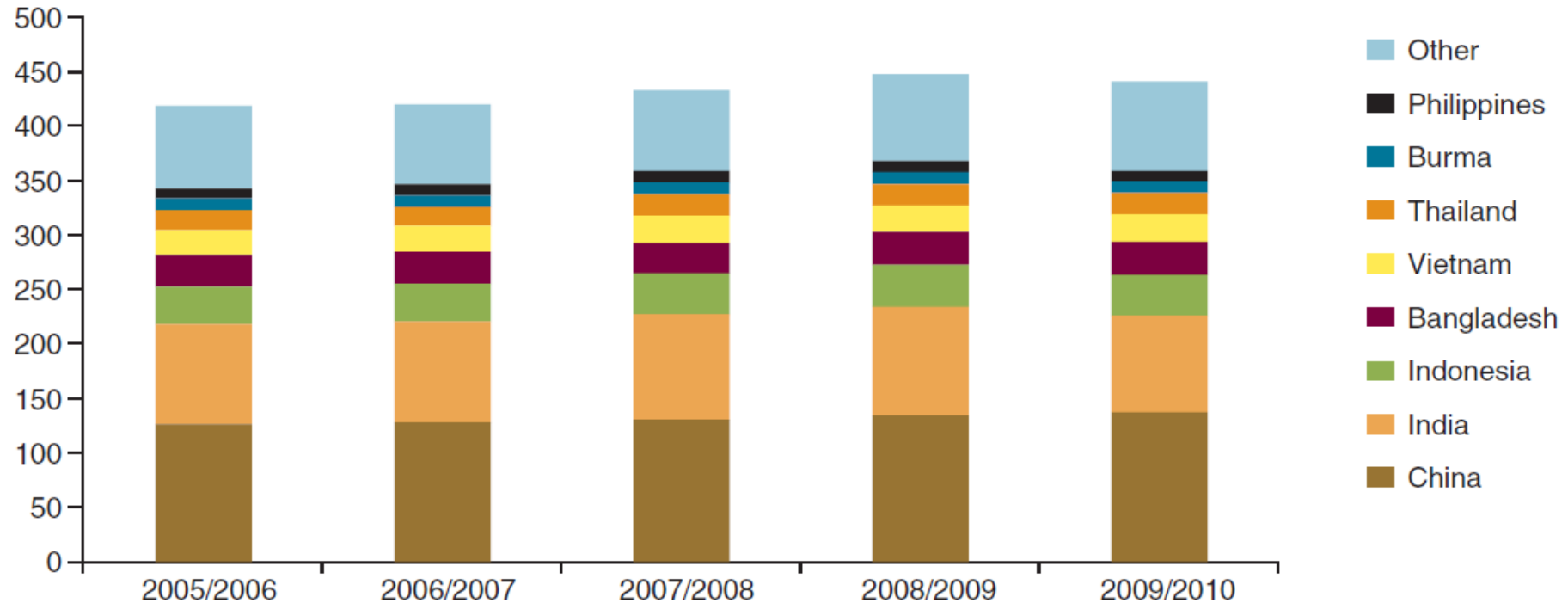


World Rice Produktion

Figure 1

India's reduced crop accounted for much of the decline in global production in 2009/10

Production (million tons)

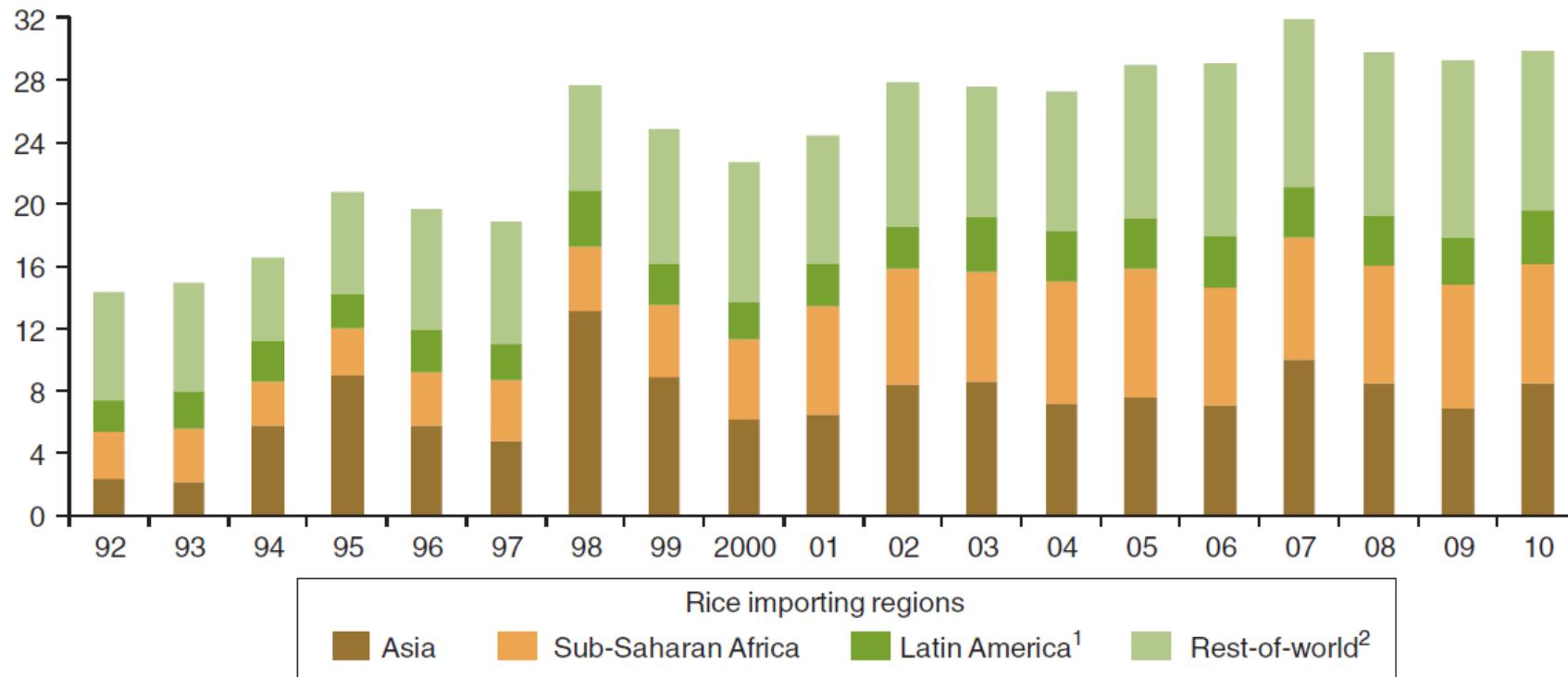


Source: *Production, Supply, and Distribution* data base, Foreign Agricultural Service, USDA, <http://www.fas.usda.gov/psd>.

Global trade - imports

Global trade is projected to increase 2 percent in 2010

Million tons (milled basis)



¹Mexico, Central America, the Caribbean, and South America.

²Includes imports not assigned a specific country.

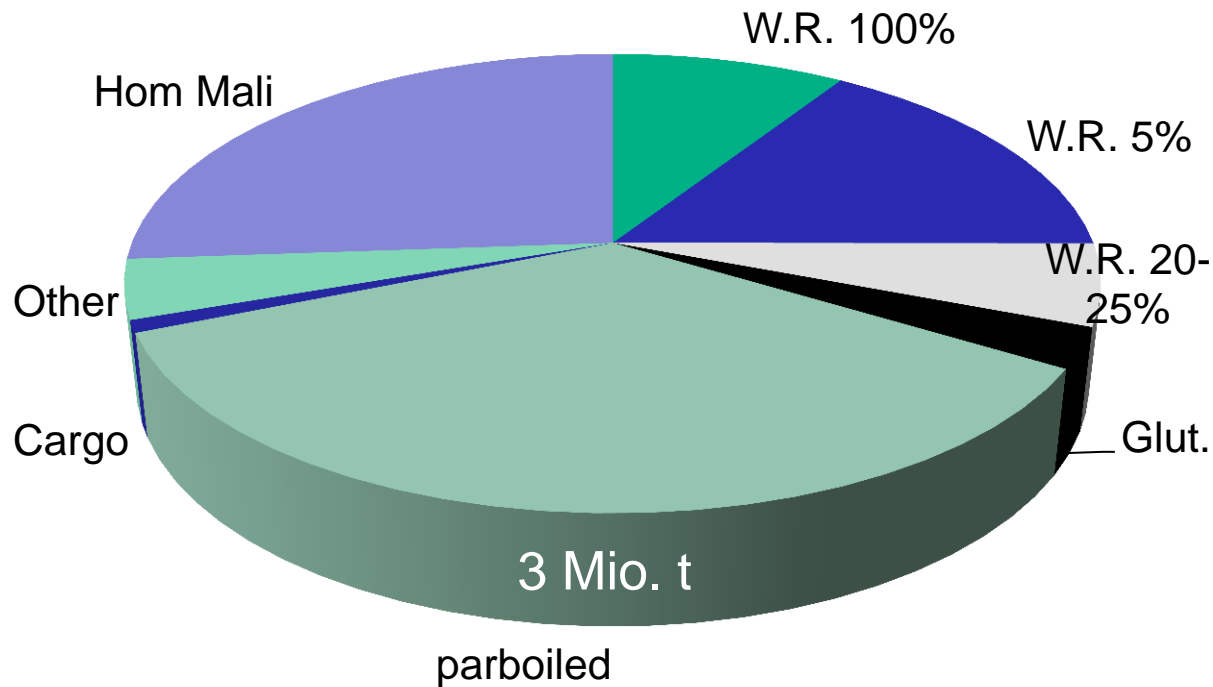
Source: *Production, Supply, and Distribution* data base, Foreign Agricultural Service, USDA, <http://www.fas.usda.gov/psd>.

Share of Parboiled Rice on the total consumption

- There are no official statistics available for parboiled rice. According to expert's opinions the shares of parboiled rice on the total consumption is:
- EU: > 50% Germany 75%, UK: 50%, France: 60%
- USA: 66%, Canada: 75%
- South America has a high share and is currently building several additional parboiling plants (Brazil)
- Nigeria is the world's biggest importer of parboiled rice
- India has an old tradition and a high share of parboiled rice
 - 60% average, higher % in the South for tradition and also to compensate poor qualities. In the North they prefer raw rice in the home kitchen, but for parties with buffets where the rice needs to be kept long and for certain dishes (Birhiani) parboiled is preferred
- Bangladesh consumes predominantly parboiled rice
- The Gulf countries also have a high share of parboiled rice because it matches well with the local food

Total rough estimate 100 Mio t of rice are consumed as parboiled rice

Thailand Rice Export 2010



Total export 9 Mio t with a value 170 Billion THB in 2010

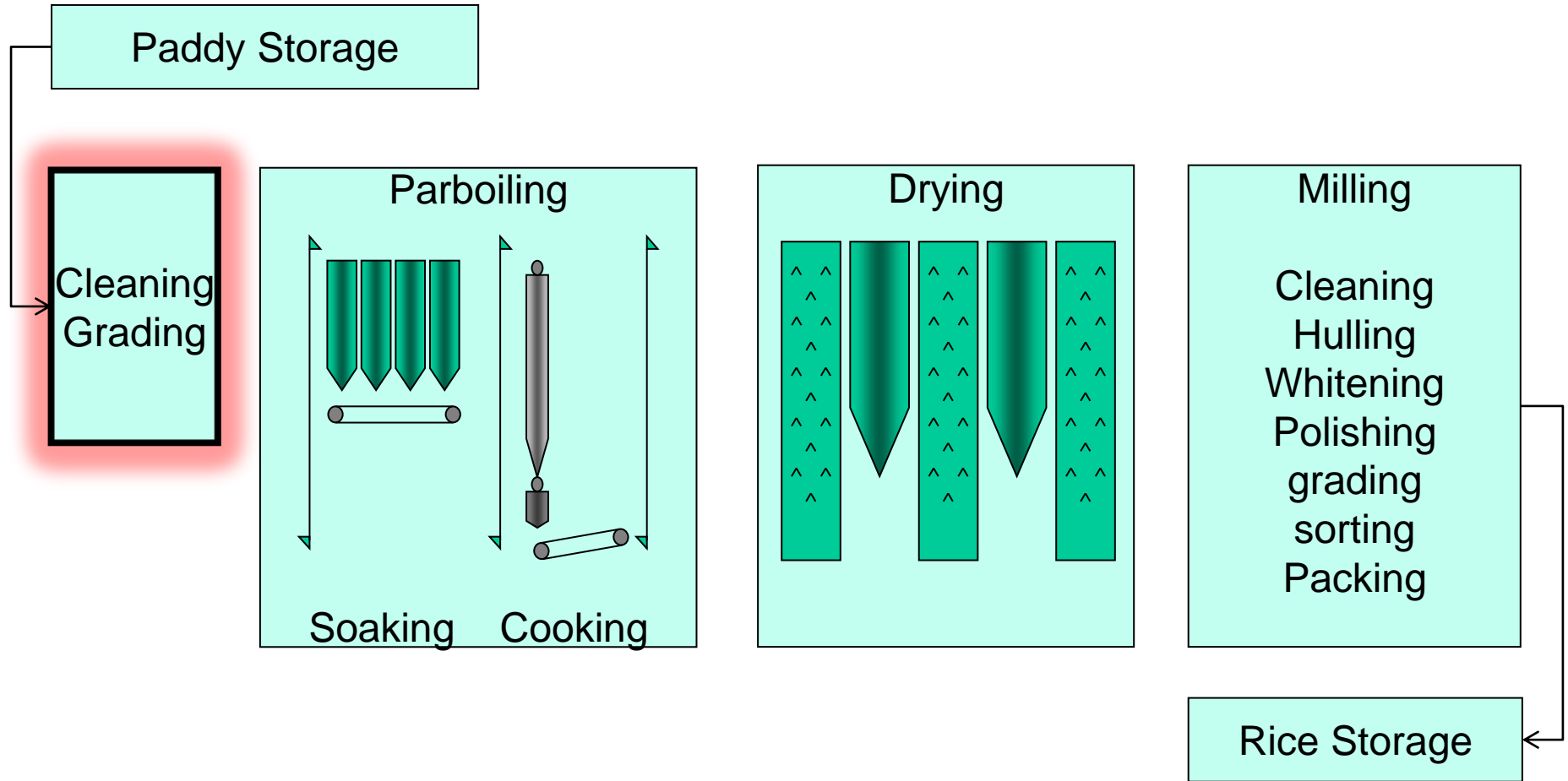
Commercial view in Thailand

Export Rice Prices

Item	11 May 11
Thai Hom Mali Rice Grade A (crop year 2009/10)	\$1143
Thai Hom Mali Rice Grade A (crop year 2010/11)	\$1004
Thai Pathumthani Fragrant Rice	\$692
White Rice 100% Grade B	\$505
White Rice 5%	\$489
White Rice 25%	\$465
White Broken Rice A.1 Super	\$423
White Glutinous Rice 10%	\$975
Parboiled Rice 100%	\$515

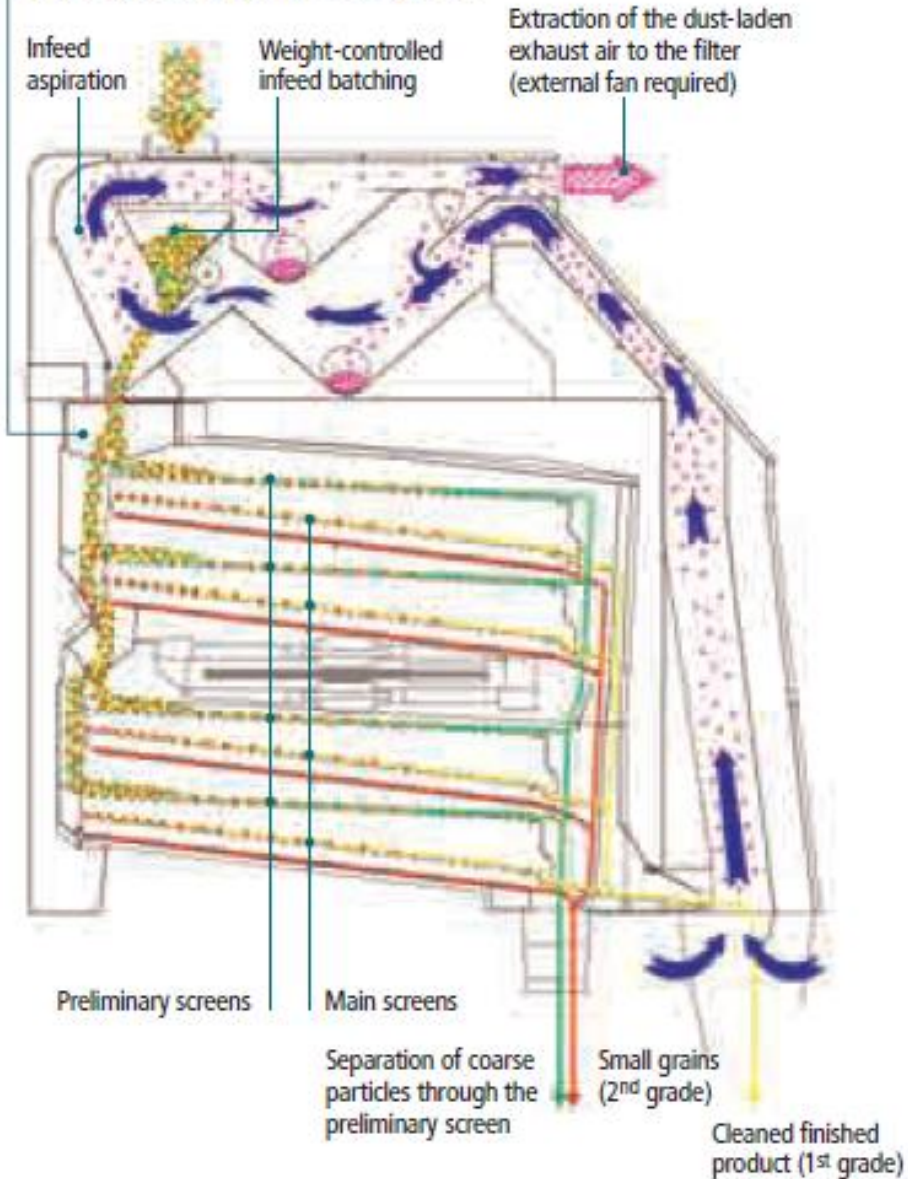
Margin for parboiling is 10 \$ plus extra gain in brokens reduction

Processing



Cleaning

Even product flow distribution to all preliminary screens, optionally available with screen change-over

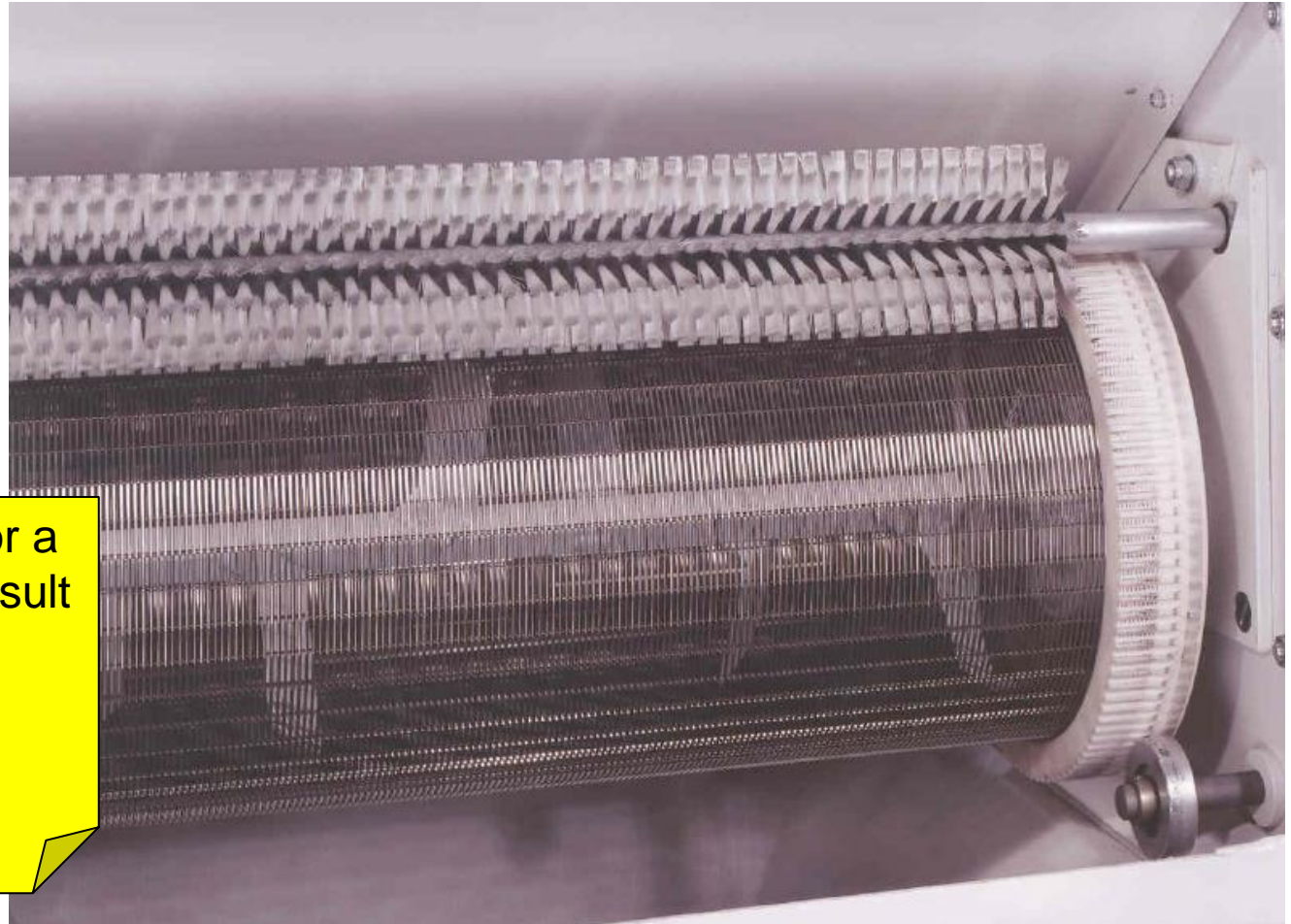


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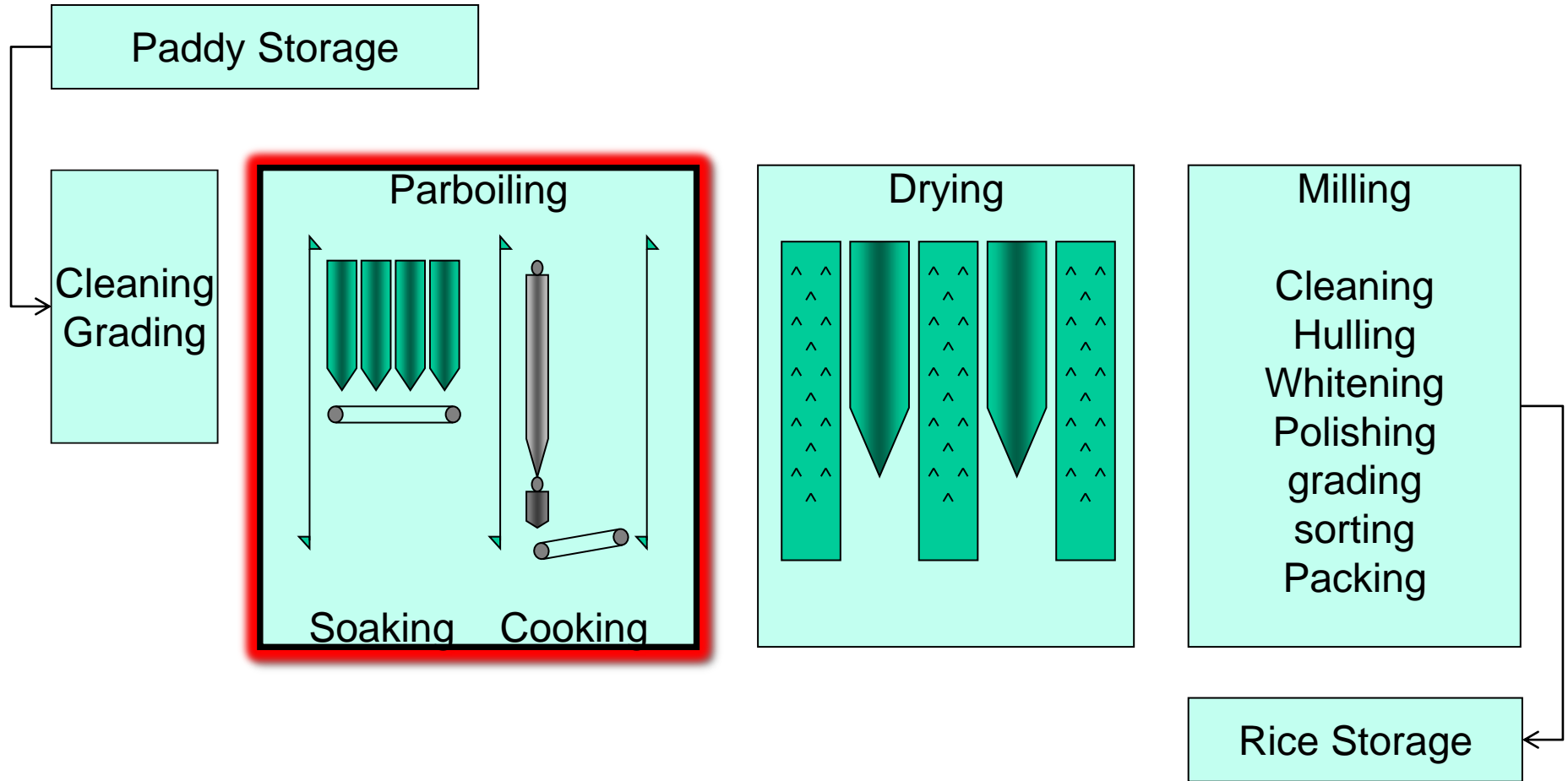


Eliminate coarse and light impurities to ensure a clean and well controlled process

Grading



Thickness grading for a uniform parboiling result
- No over-boiled or under boiled grains



- Soaking and cooking depend on each other: A good process needs to optimize both processes
- Soaking – *parameters temperature and time*
 - Clean water
 - Even process – soak every grain for the same time
 - Good control of the soaking temperature and soaking time
- Cooking – *parameters pressure and time*
 - Pressure must be applied to produce medium and dark golden qualities
 - All grains same time and same pressure
 - Good control of pressure and cooking time

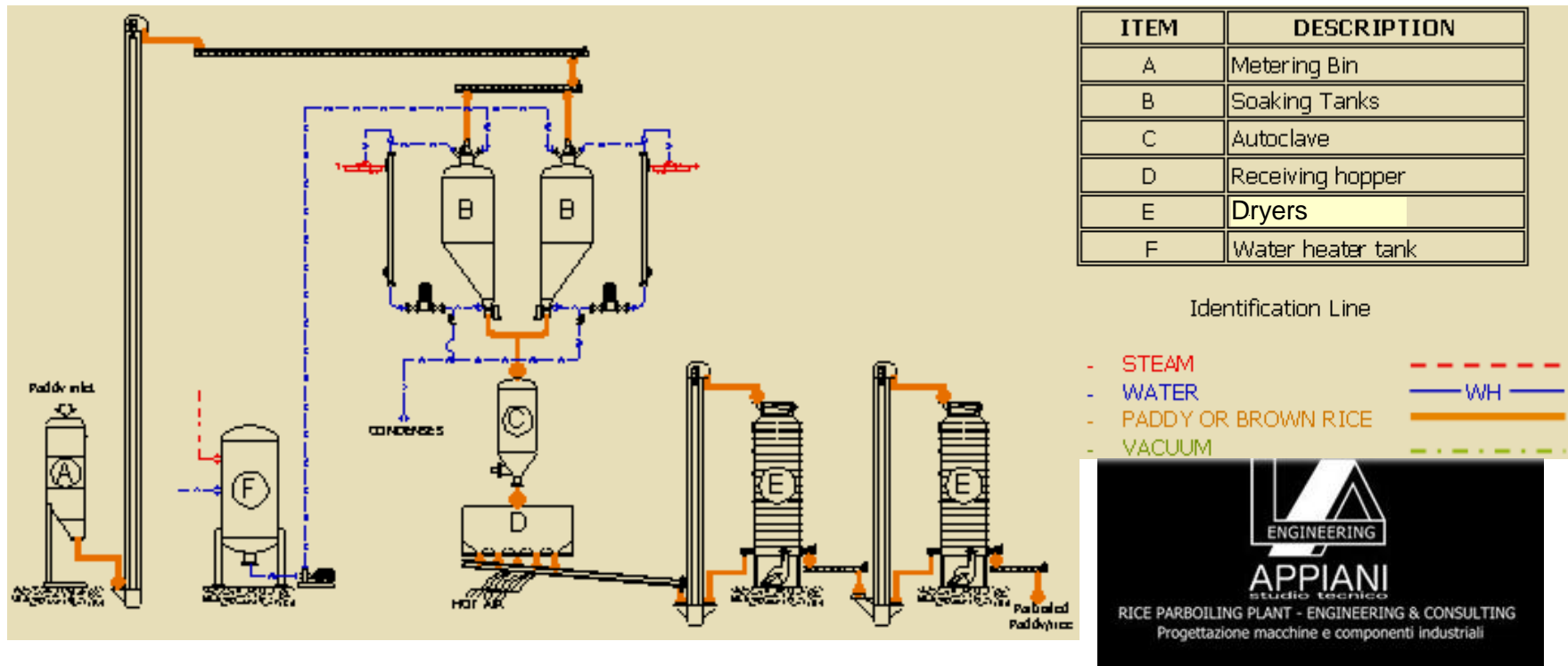
Parboiling 3 processes

- Batch process
 - Smaller capacities, each batch is controlled separately
- Continuous pressure cooking process
 - High capacities, good process control
- Gariboldi process
 - Smaller capacities, high flexibility, highest investment



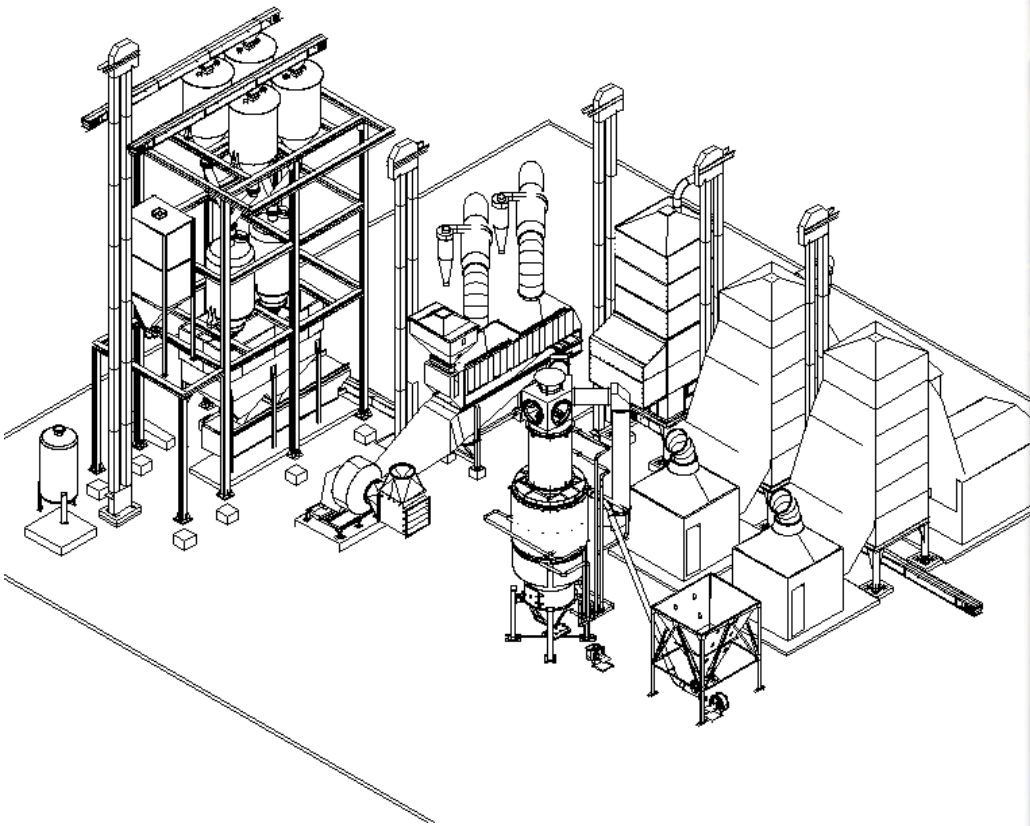
Parboiling *vertical batch plant*

- A batch is soaked (B) and then filled into the cooker (C). The cooker is then shut and pressurized for the cooking process. The product is then released into the drying section (D and E).
Then the batch from the second soaking tank (B) is filled into the cooker and the cycle begins again

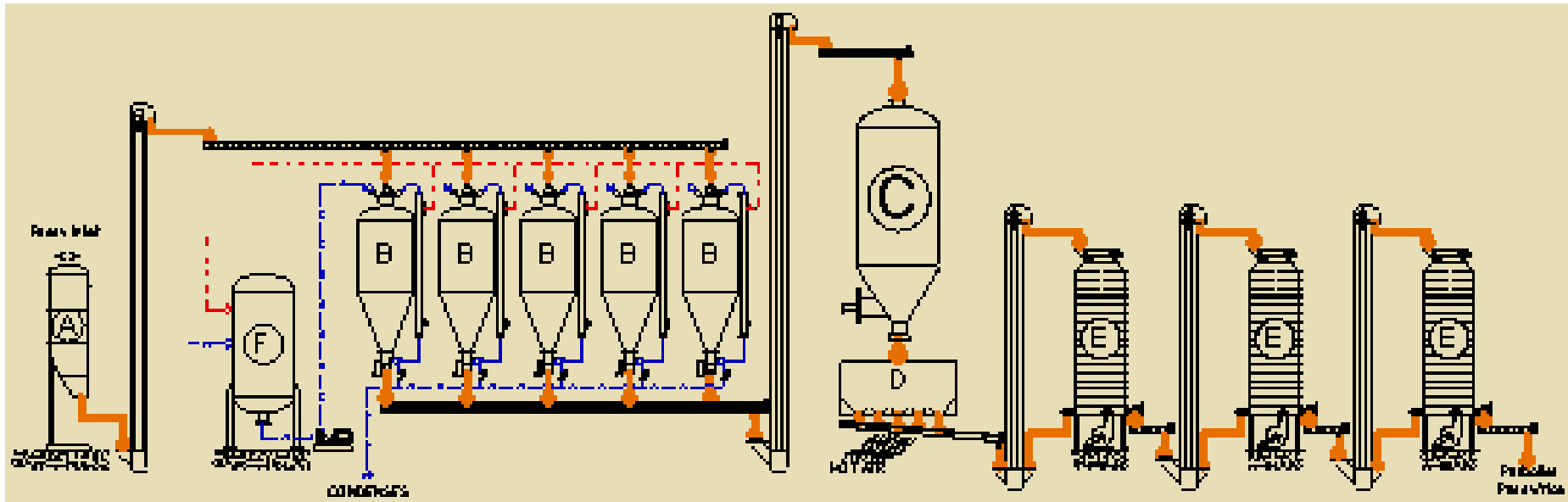


Parboiling batch system

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Continuous pressure cooking



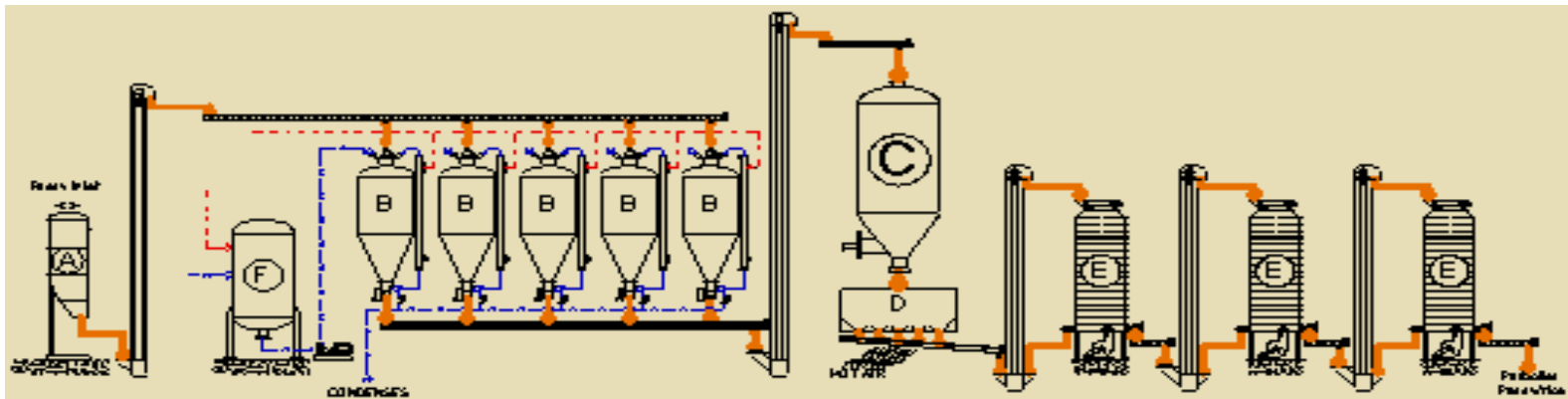
ITEM	DESCRIPTION
A	Metering Bin
B	Soaking Tanks
C	Autoclave
D	Receiving hopper
E	Drying tower
F	Water heater tank

Identification Line

- STEAM - - - - -
- WATER - - - - -
- PADDY OR BROWN RICE - - - - -
- VACUUM - - - - -

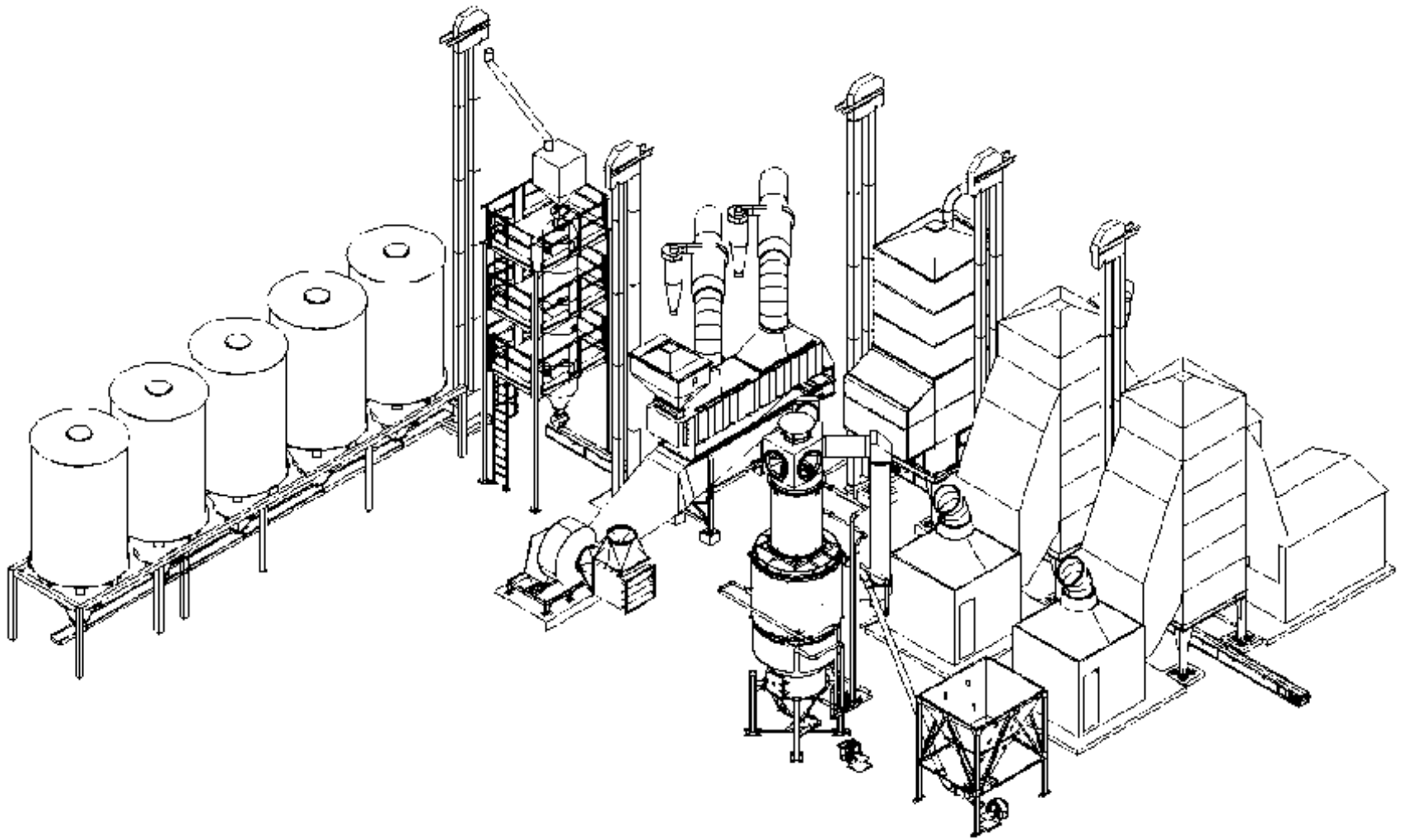
Continuous pressure cooking

- The soaking bins (B 1 – 5) are filled in sequence. For the continuous process, the soaking has to work with defined soaking and discharge times to feed the cooker continuously. The water temperature is ~ 60 C. The soaking time is ~ 4 to over 6 hours, depending on the type of rice.
(product temp. 60 C, moisture 29 to 32%)
- The cooking time in the continuous pressure cooker (C) is 18 to 35 min and the pressure 1 to 1.5 bar (abs) or even more for special purposes. The cooking time is controlled by the feed rate which is well synchronized with the soaking system.
(product temp. 100 C, moisture 33%)



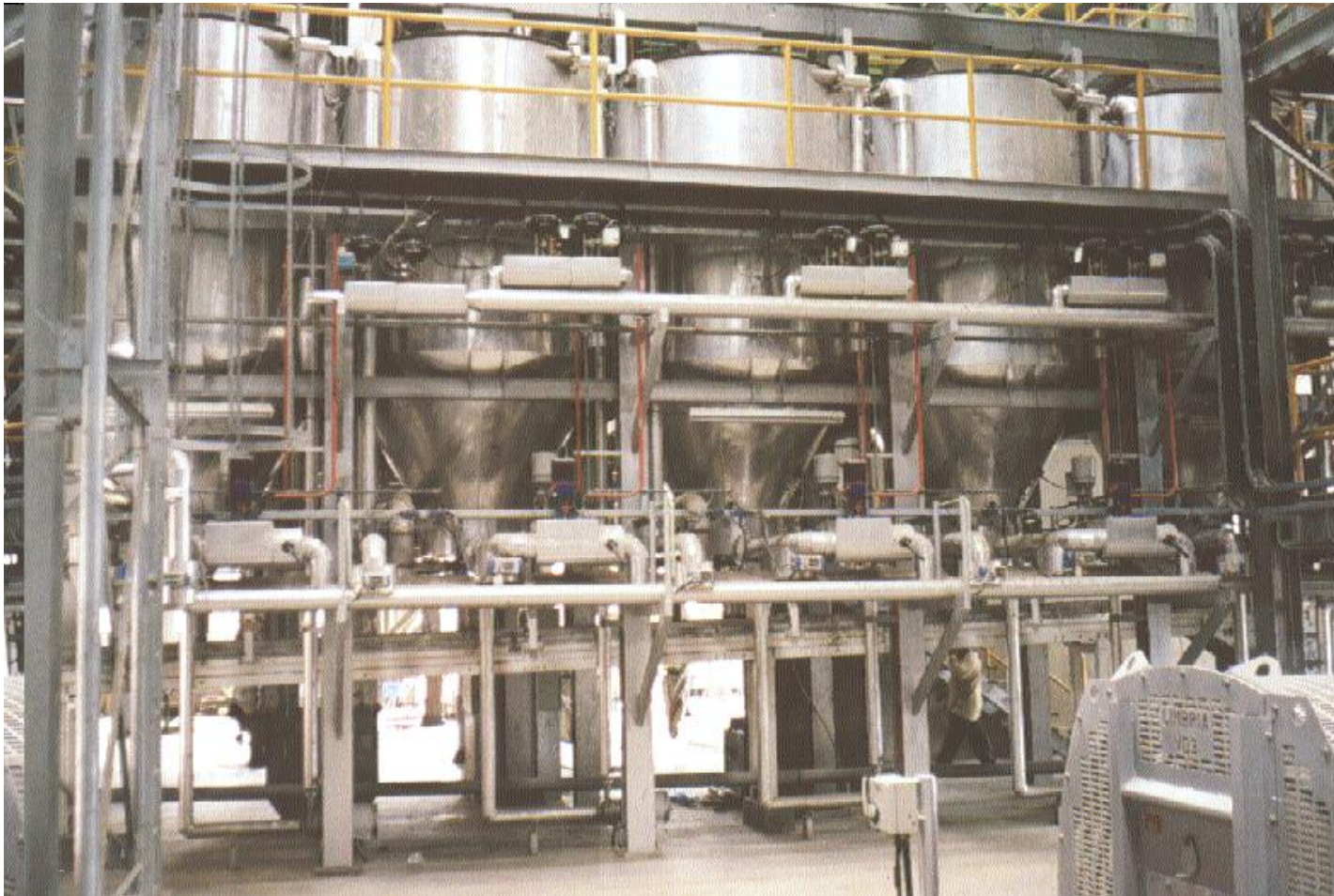
Continuous pressure cooking

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Continuous pressure cooking

- State of the art soaking bins



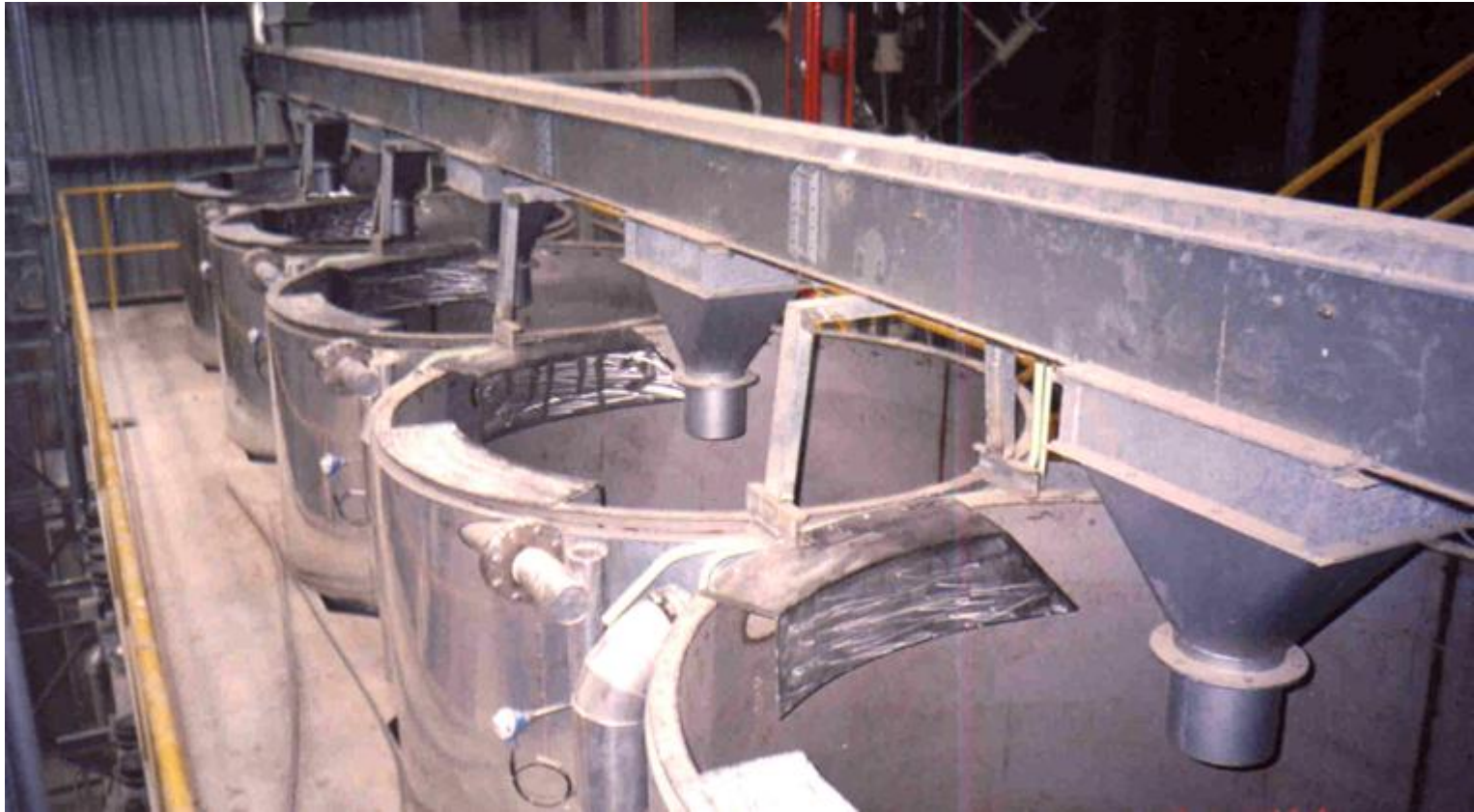
Continuous pressure cooking

- State of the art soaking bins discharge



Continuous pressure cooking

- Modern soaking tanks top view, stainless steel, water inlets



Continuous ambient cooking in Thailand

- Soaking tanks in Thailand
- All connected in parallel, no individual control of flow and temperature or water exchange is possible



Continuous ambient cooking in Thailand

- Soaking tanks



Continuous cooking

Modern automatic soaking discharge

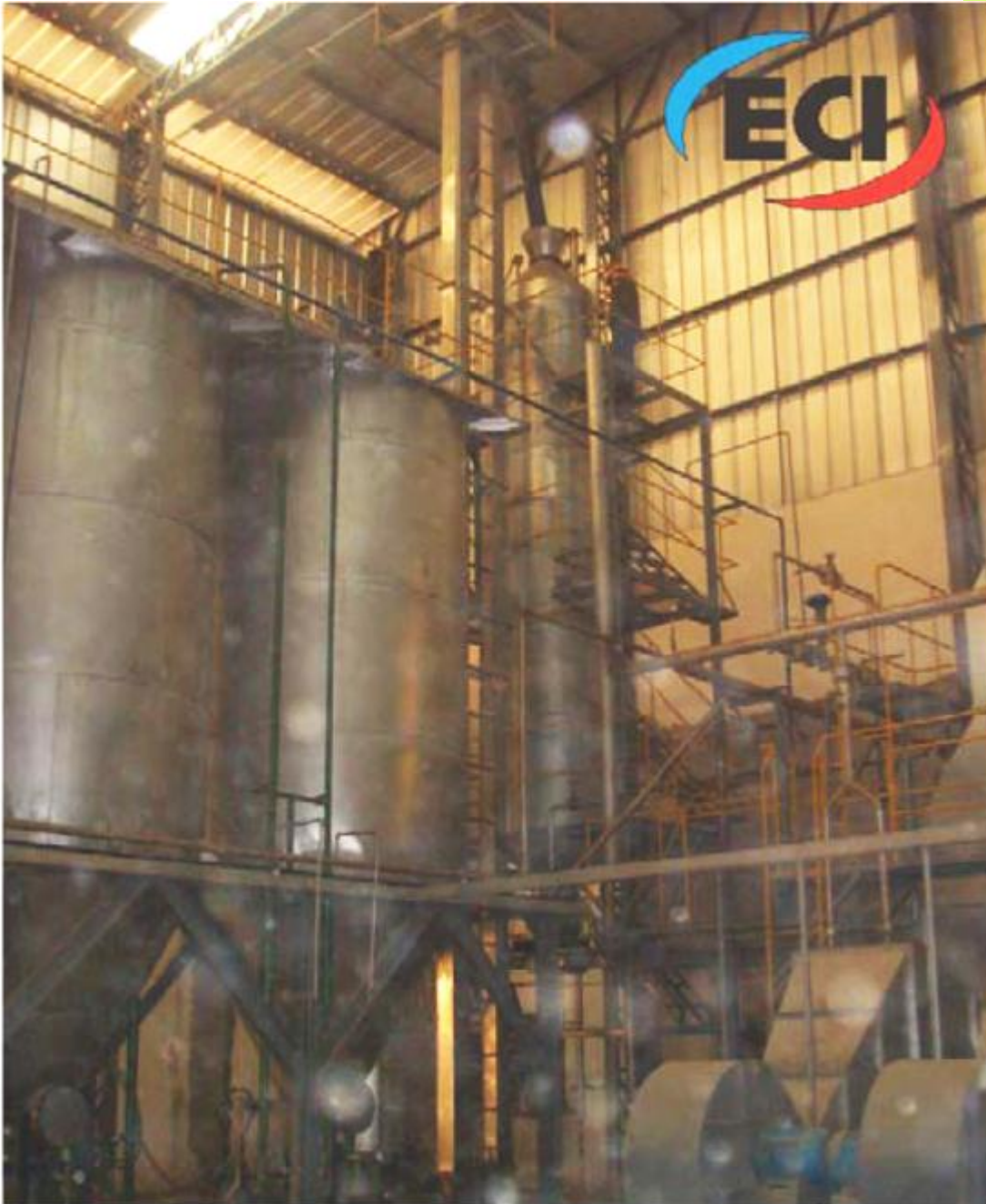
Manual control of the discharge





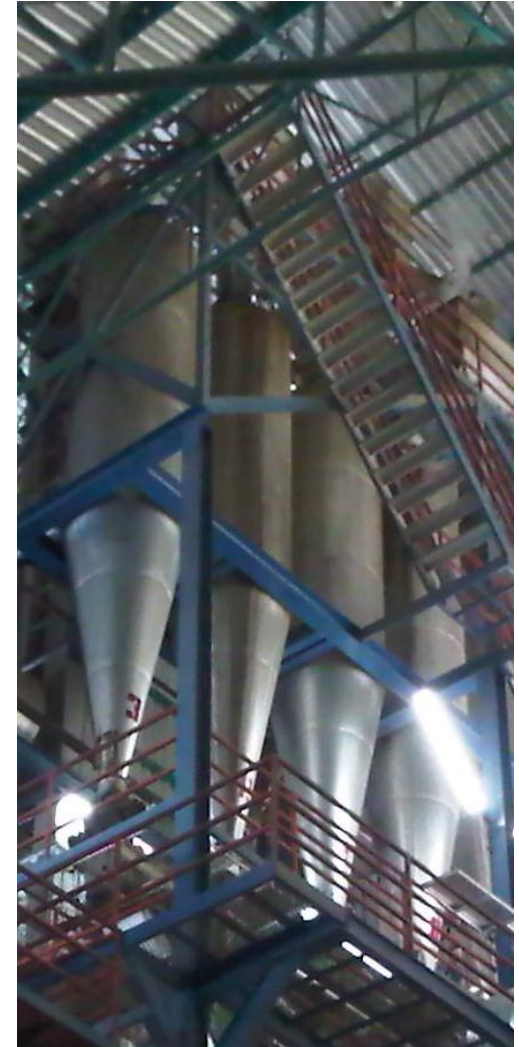
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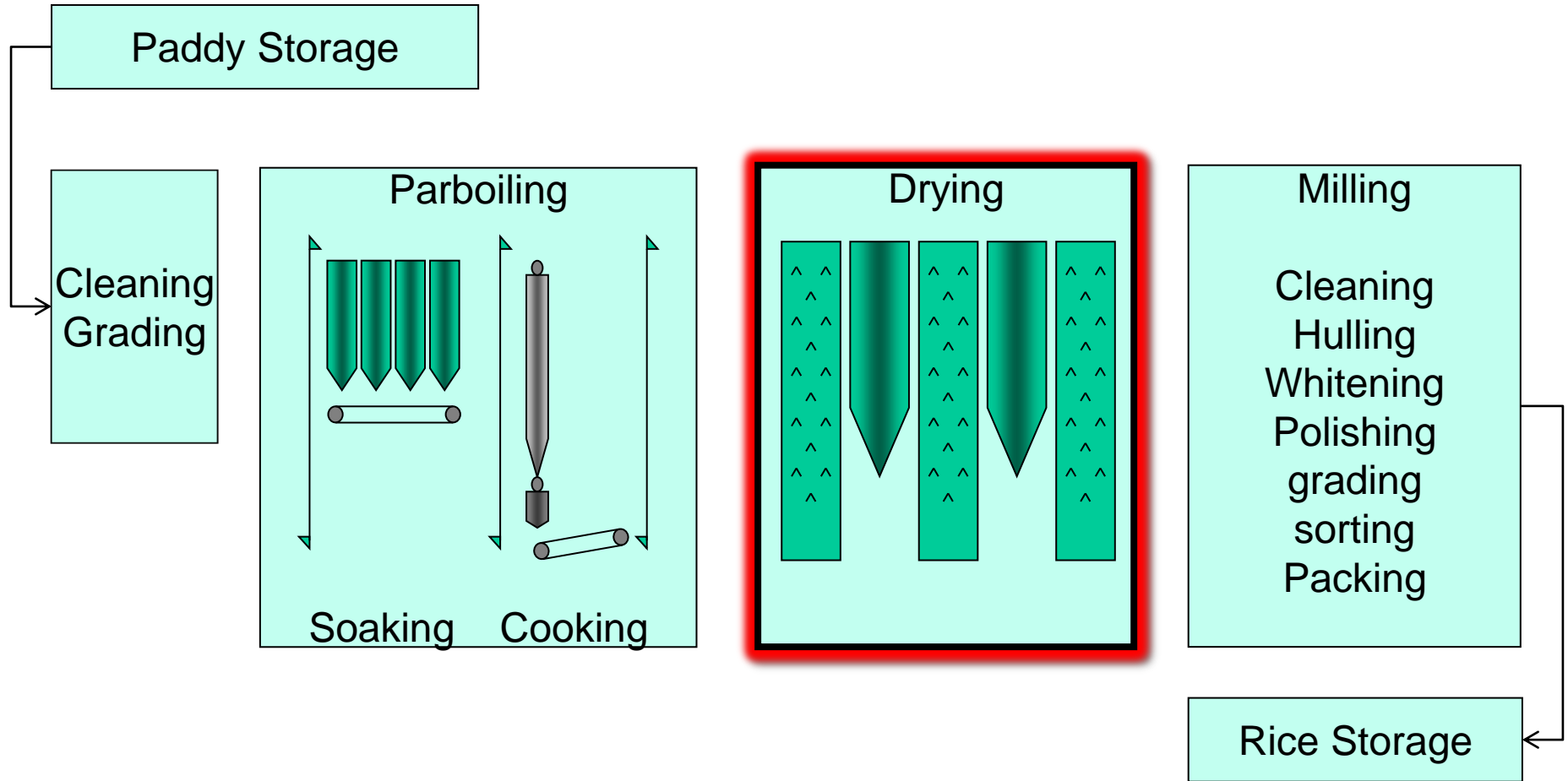
Continuous pressure
cooking In Italy



Continuous ambient pressure cooking in Thailand

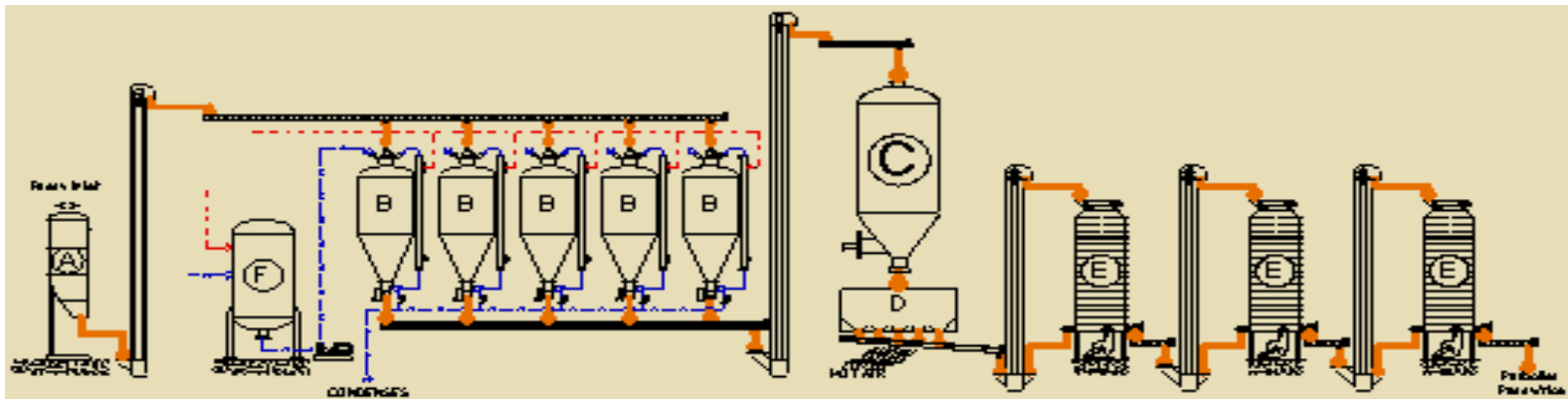
- Continuous cookers
- However, only for ambient pressure
- Limited to bright colour qualities
- No pressure reserves available for adjustments



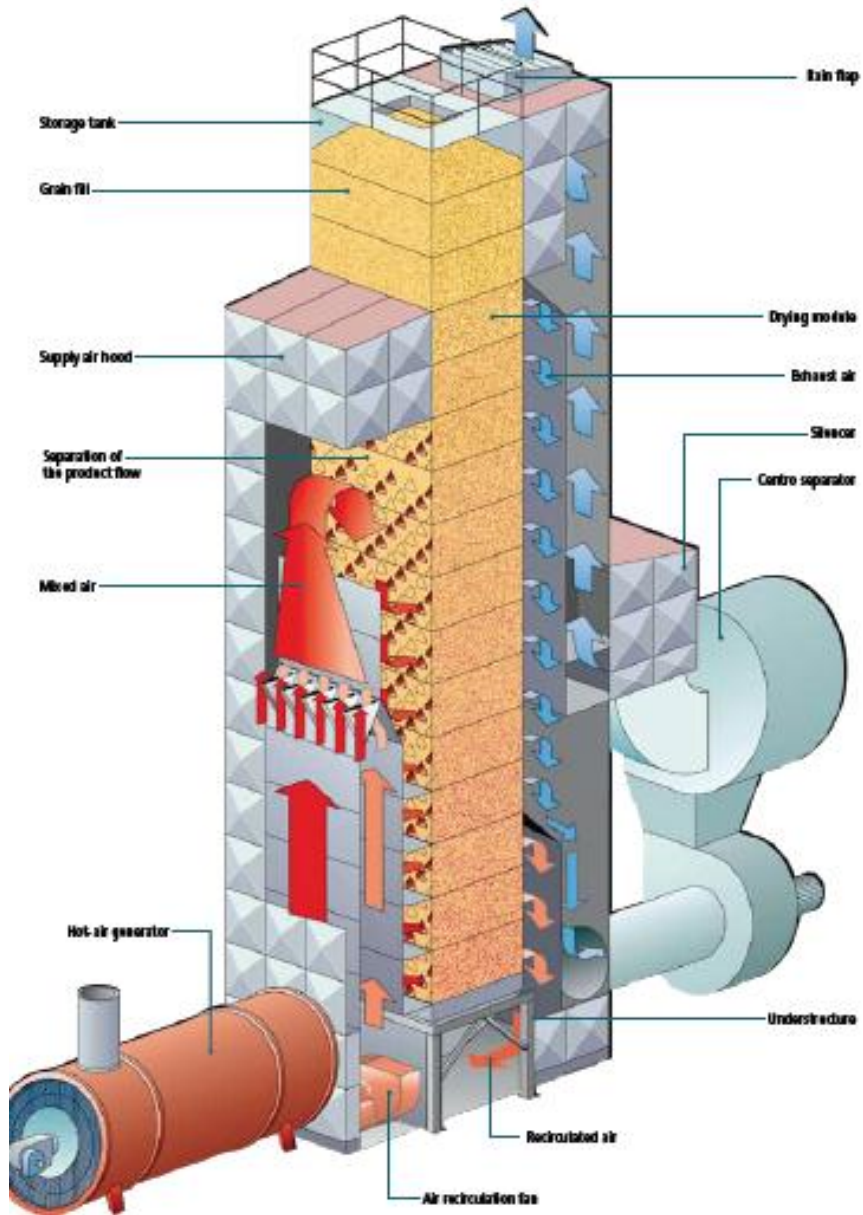


Drying for Continuous pressure cooking

- The first step drying can be done in a fluid bed dryer or similar device, eliminating the high surface moisture and using the high product temperature (product temp. ~ 80 C, moisture ~ 30 %)
- The main drying is done carefully in 3 passes with good tempering times between the passes: 30% -33% to 20%; 20% to 16%; 16% to 14%)
- Energy source is usually paddy husk, heat exchangers are recommended to comply with western health regulations



Dryers



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Parboiling

- Dryers
- Old: 8 to 10 passes, flue gas heated
- New: 3 passes, indirect heating for food grade product



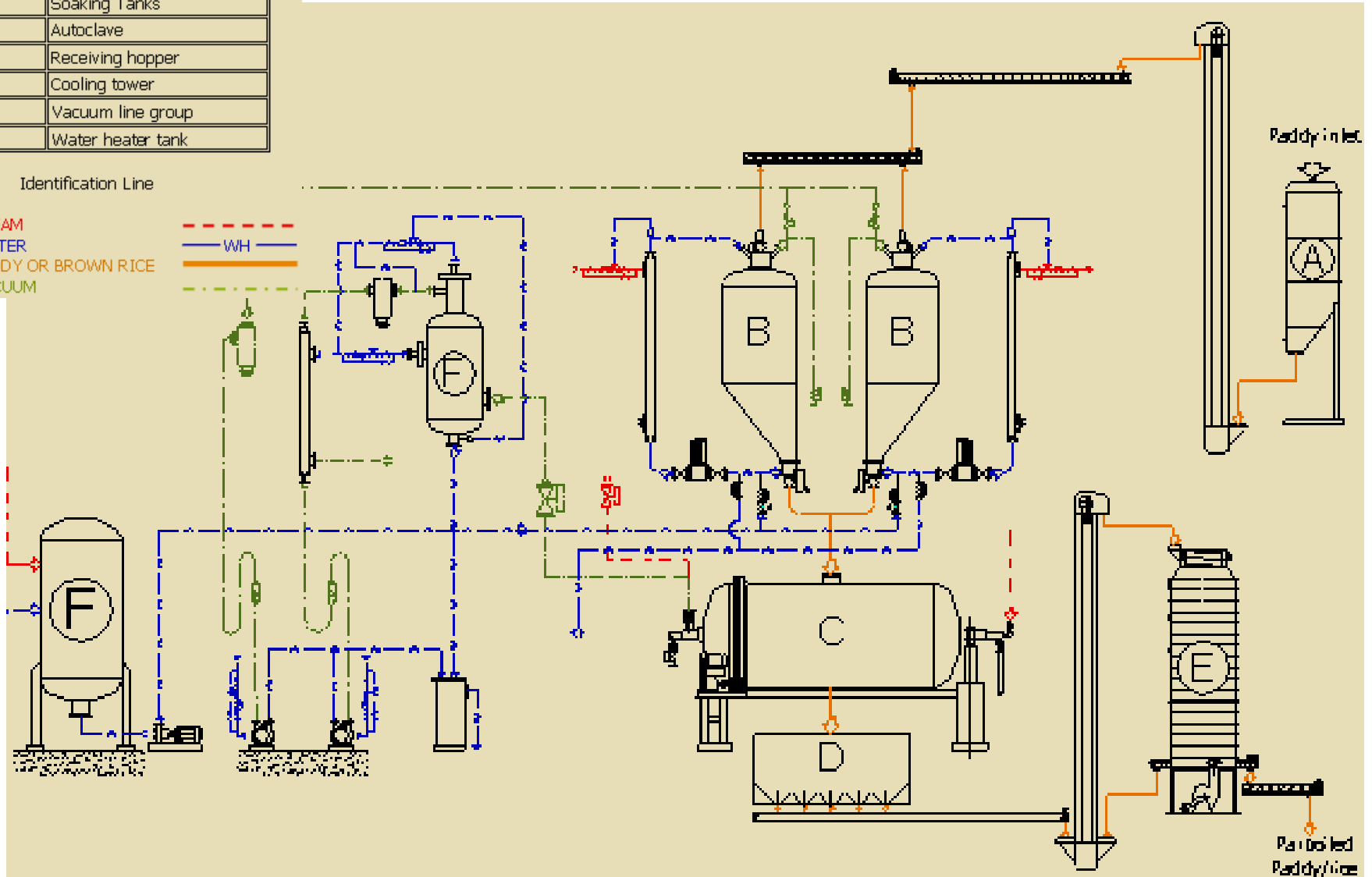
Gariboldi Process

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ITEM	DESCRIPTION
A	Metering Bin
B	Soaking Tanks
C	Autoclave
D	Receiving hopper
E	Cooling tower
F	Vacuum line group
G	Water heater tank

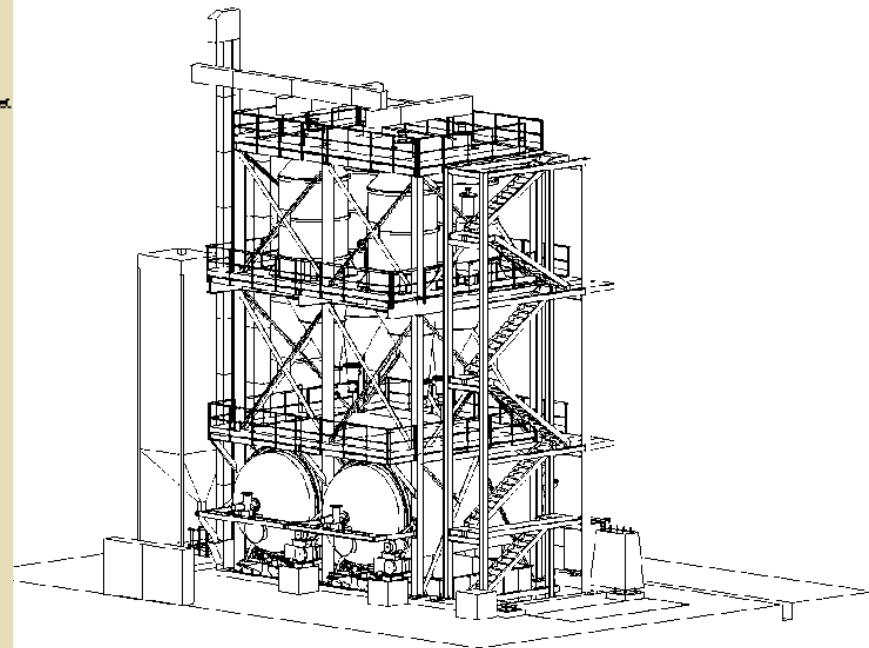
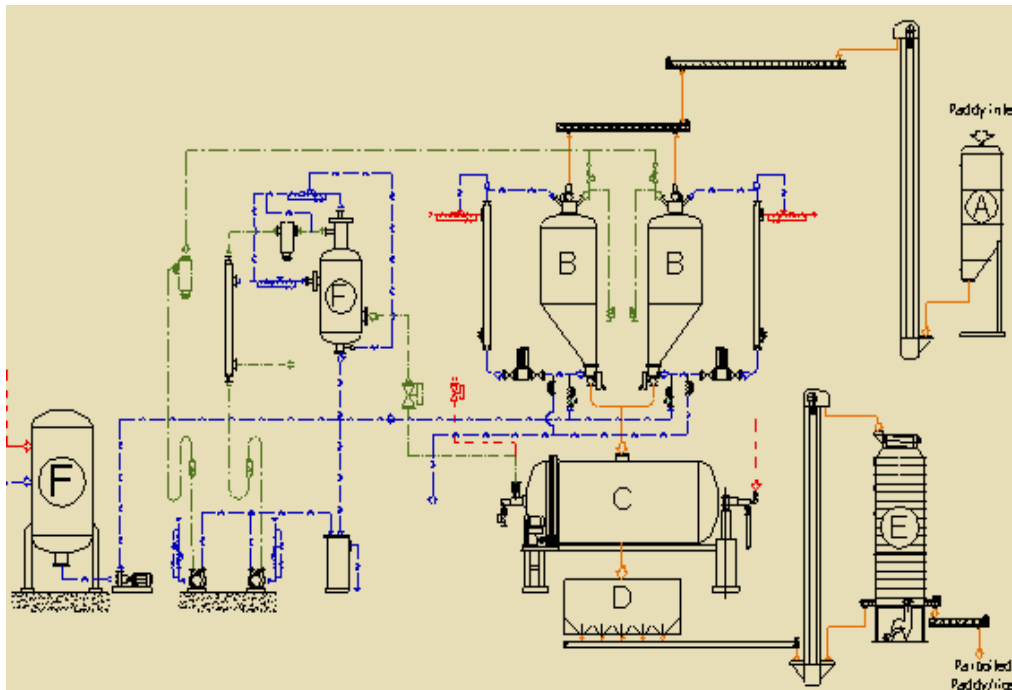
Identification Line

- STEAM (Red dashed line)
- WATER (Blue dashed line)
- PADDY OR BROWN RICE (Orange solid line)
- VACUUM (Green dashed line)



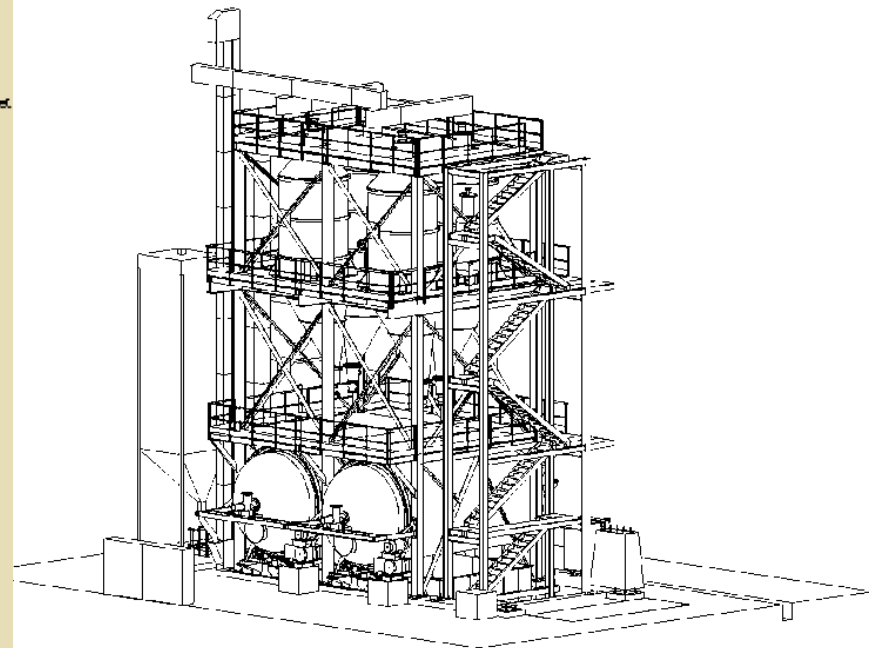
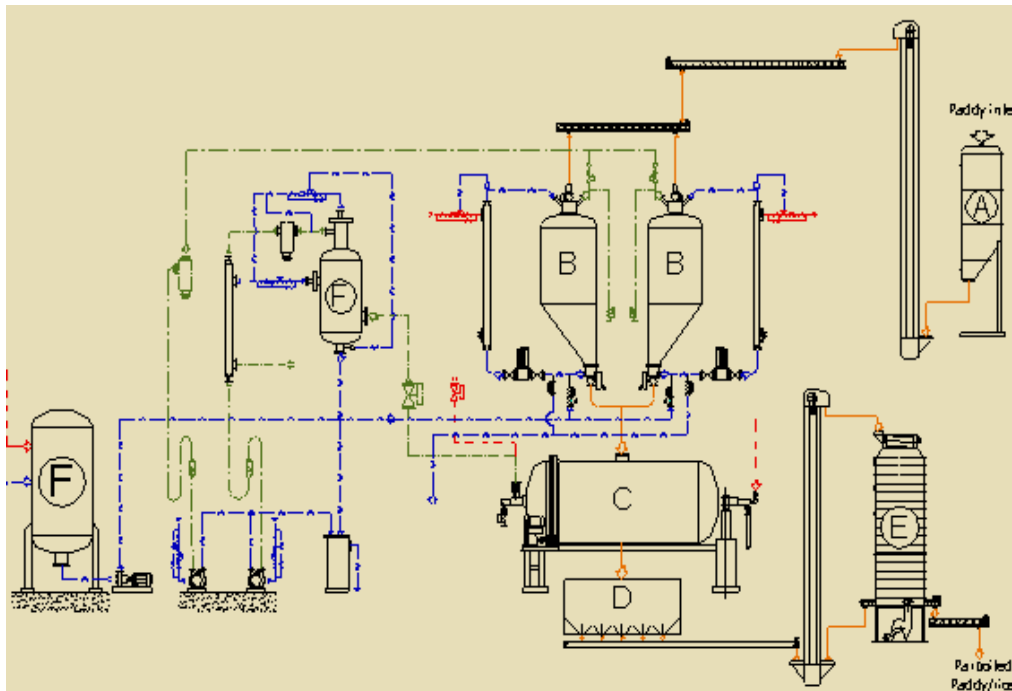
Gariboldi Process (1)

- The process works in cycle times of 6 h
- Input is 2,5 t/h clean, graded paddy
- The soaking bins (B 1 – 2) hold 15 t each and are filled in sequence. Before filling the water, vacuum is drawn to speed up the water penetration. Once filled with water (~65 C), the tanks will be pressurized to reduce the soaking time to ~5 h.



Gariboldi Process (2)

- The autoclave (C) also takes 15 t. After filling, steam is directly injected and the system is pressurized. After the cooking process vacuum is drawn in the same vessel for drying. In addition indirect heating is applied.
- At the end of the cycle, dry (14%) hot product leaves the autoclave to the final cooling stage (E).
- No additional dryers are needed



Gariboldi system 2,5 t/h



Autoclave

- Indirect heating with steam pipes *and*
- Direct steam injection into the autoclave



Gariboldi system Riso Viazzo



Parboiling laboratory

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simulates the full process
in 1 kg batches.

Find the best
parameters before
big quantities
are at stake

3 batches can be
Soaked at different
parameters at the
same time
1 pressure cooker
and vacuum dryer

Full Gariboldi
technology



Comparison 10 t/h Continuous Steam Cooking System - Gariboldi Technology

	Continuous Pressure Cooking System	Gariboldi Technology
Raw product	paddy	paddy or brown rice
Product preparation cleaning grading	same	same
layout	one continuous cooker 10t/h	4 lines @ 2,5 t/h
soaking	5 ambient air soaking tanks for semi-continuous processing	2 vacuum & pressure soaking tanks for batch processing to reduce soaking time
Cooking process		
equipment	Vertical pressure vessel with airlocks for feed and discharge of the product.	Batch type horizontal rotating autoclave
Cooking parameters	Feed rate	process time,
Pressure range	0,3 to 0,5bar	0,4 to 2 bar
Drying and tempering		
equipment	Separate classical dryers	Vacuum drying in the same autoclave plus cooling tower

Comparison 10 t/h Continuous Steam Cooking System - Gariboldi Technology

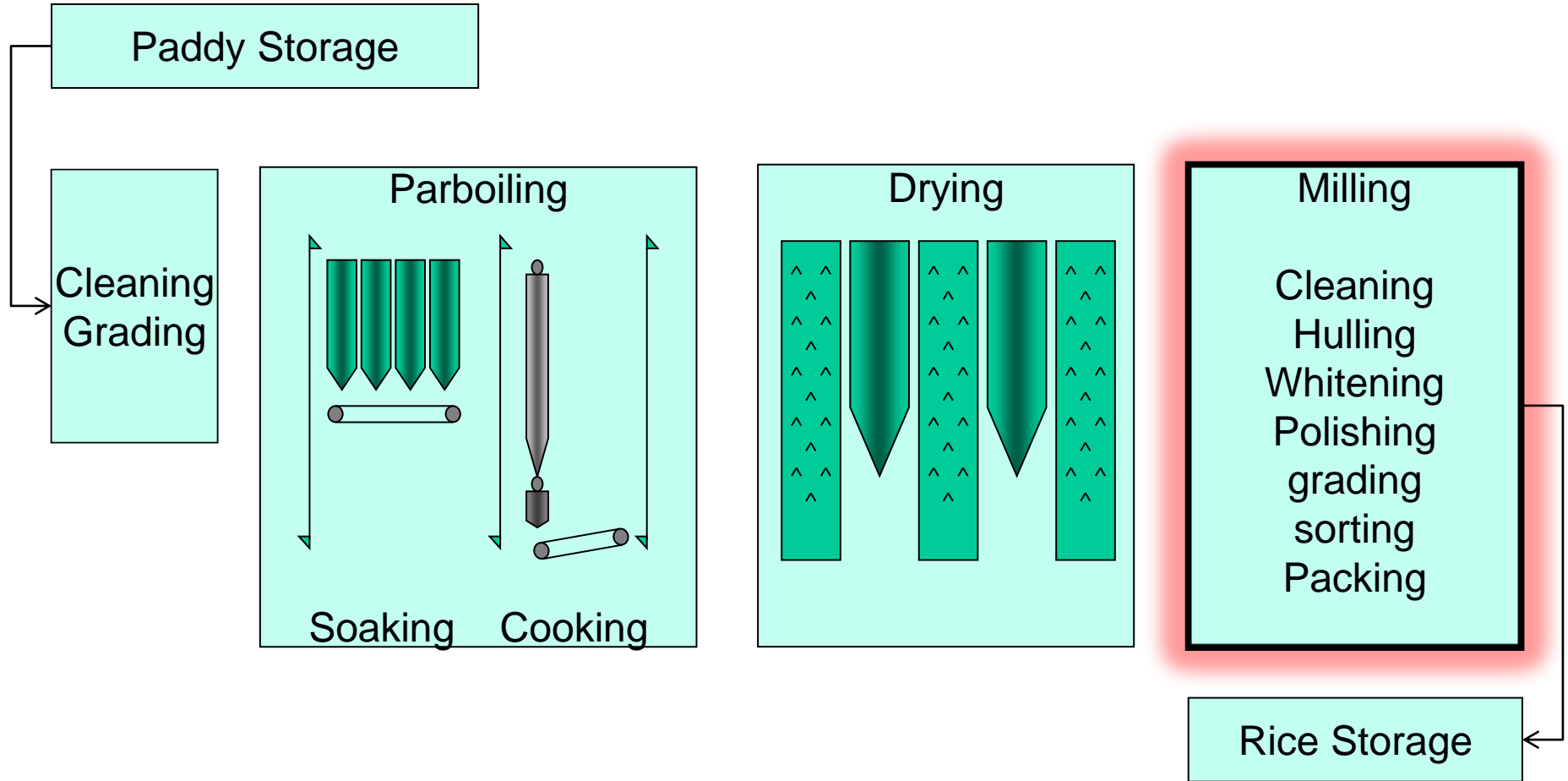
	Continuous Pressure Cooking System	Gariboldi Technology
Consumptions for 10 t/h processing capacity		
consumption of saturated steam at 8 bar average / maximum incl. dryer	9500 Kg/h	Max 5500 kg/h
Consumption of industrial water	0	3 m ³ /h at 4 bar
Consumption of drinking water	10 m ³ /h at 4 to 5 bar	10 m ³ /h at 4 to 5 bar
Power requirement	550 KW installed	420 KW installed, 220 KW consumed

Comparison 10 t/h Continuous Steam Cooking System - Gariboldi Technology

	Continuous Pressure Cooking System	Gariboldi Technology
Other criteria		
taste		The vacuum technology improves the taste by conserving natural flavours and reducing the process time.
Investment equipment (estimate, if all components are imported) Reduction is possible by manufacturing part of the equipment locally	1,9 Mio EUR, if all components are imported	5,9 Mio EUR, if all components are imported (recirculation group 70'000 EUR)
Requirement for building		
Personnel for operation	Needs min, 2 person to run 24 h/day	1 person shifts only
Cost of maintenance : the continuous system is more expensive that Gariboldi Technologies		
Flexibility on market	Adjustable to different types of paddy, adjustment of colour	Very high, wide range of raw products, colours and cooking properties can be produced - Besides possibilities to put brown rice intake – obtain special parboiled rice

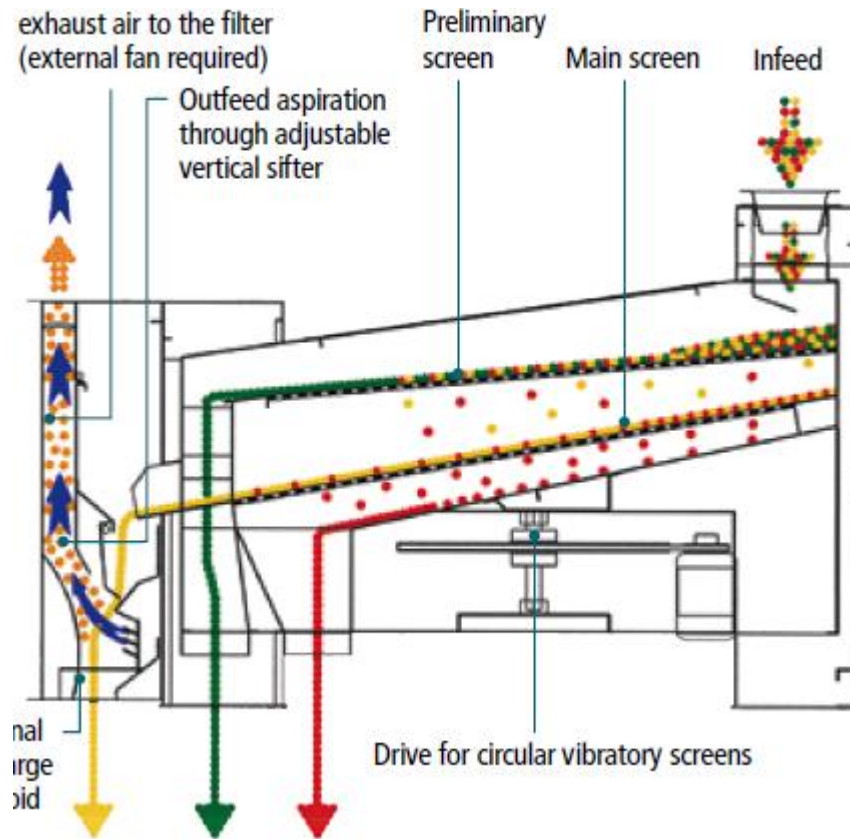
Comparison paddy / brown rice parboiling

	Input product paddy	Input product Brown rice
Market share	>90% of parboiled rice is made of paddy world wide	<<10%
breakens	Less breakens, as the grains are hardened, before they leave the protecting husk	More breakens: all breakens of the hulling process remain, few additional breakens in the polishing step
Smell: 90% of the smell quality depends on the sanitation in the equipment, to avoid microbiological activities	Aroma is slightly different to brown	Depending on taste, especial in Asia, might be considered better smell
Energy consumption: Same installed power, but process time is different, for example:	Process time 6 hrs	Process time 4,5 hrs, so less power consumption for steam and water



Milling of parboiled rice

- Fine cleaning



Milling of parboiled rice

- Hulling
 - High hulling degree, as hard grains allow a high roll pressure
 - Less broken



Milling of parboiled rice

- Abrasive whitening
 - Less broken
 - Sticky bran
 - → coarser stones at higher speeds
 - → strong aspiration, short ducts

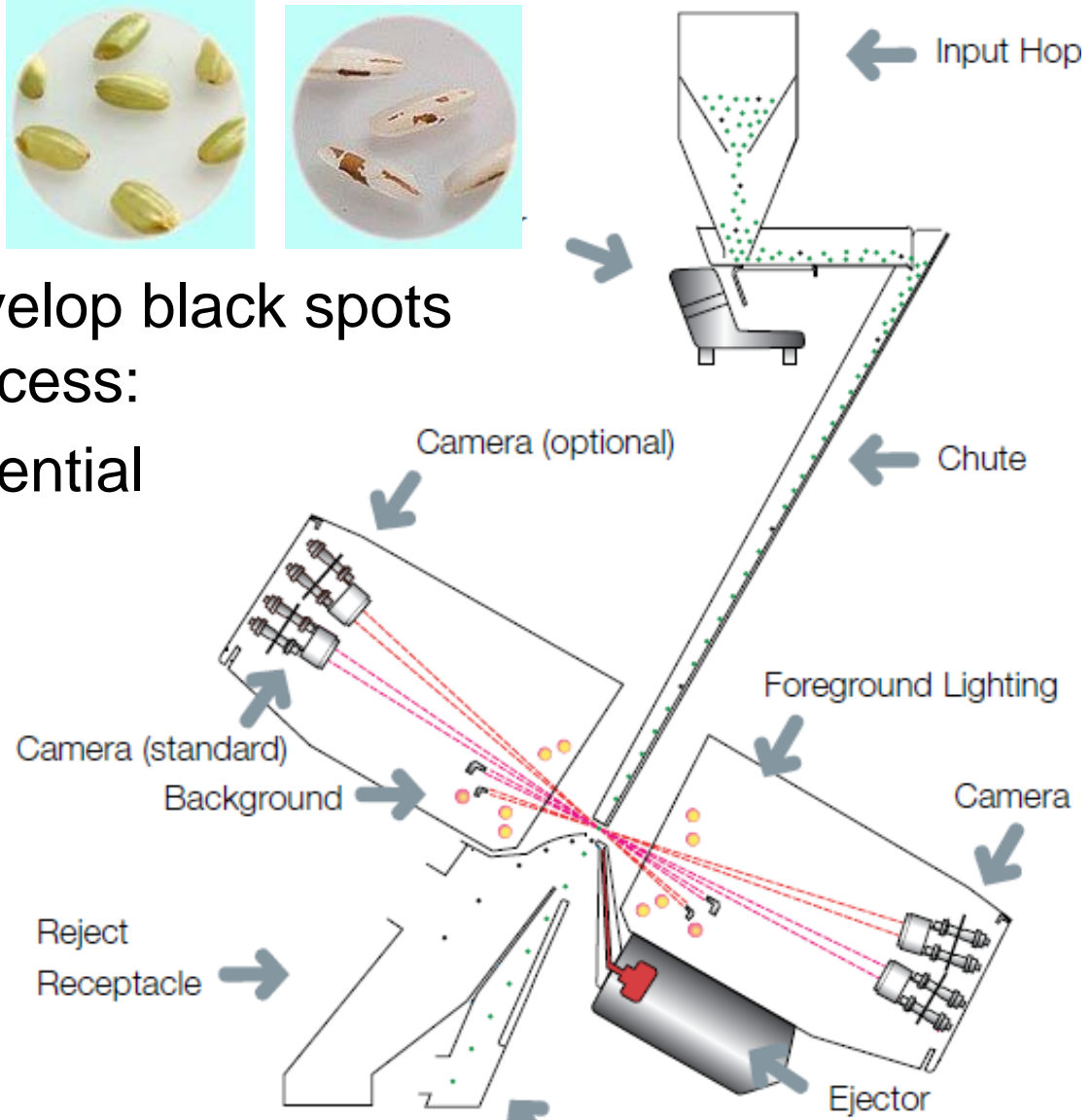


Milling of parboiled rice Grading

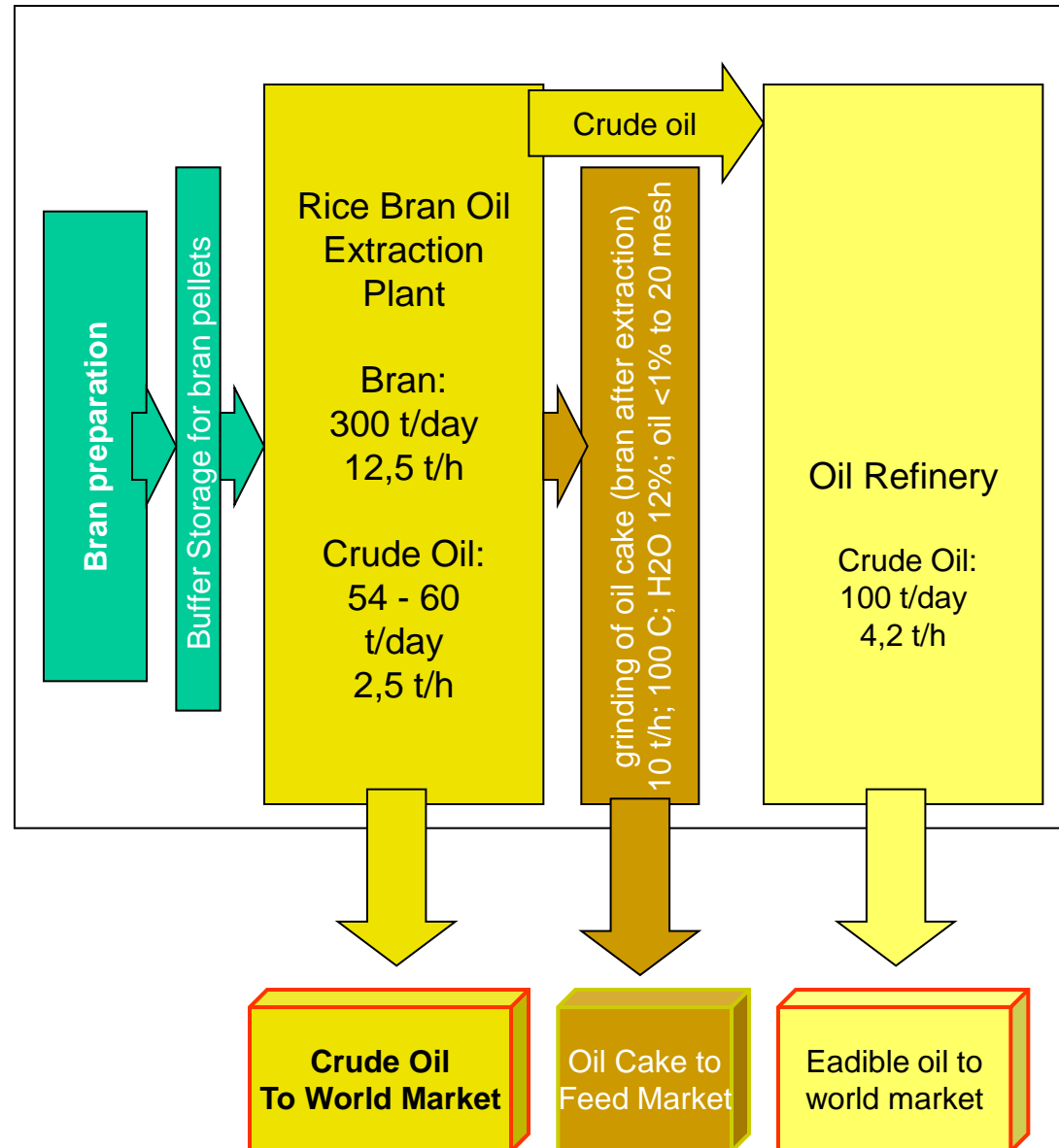
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- Damaged grains develop black spots in the parboiling process:
- Colour sorting is essential



Bran oil extraction



- Bran of parboiled rice is more stable than raw bran
- Bran of parboiled rice contains more oil than raw bran



Healthy

After milling, parboiled rice still contains about 80 percent of the vitamins and minerals contained within the paddy rice, making it particularly valuable in nutrition terms with regard to ones daily diet.

Keeps longer

Even after keeping it hot in a pot for hours, cooked parboiled rice stays particularly fluffy.

Consistently separate and fluffy

During the parboiling process, the grain's starch gelatinizes, giving an extra hard grain. When cooked, parboiled rice does not produce the stickiness that is typical of other rice varieties and is fluffier.

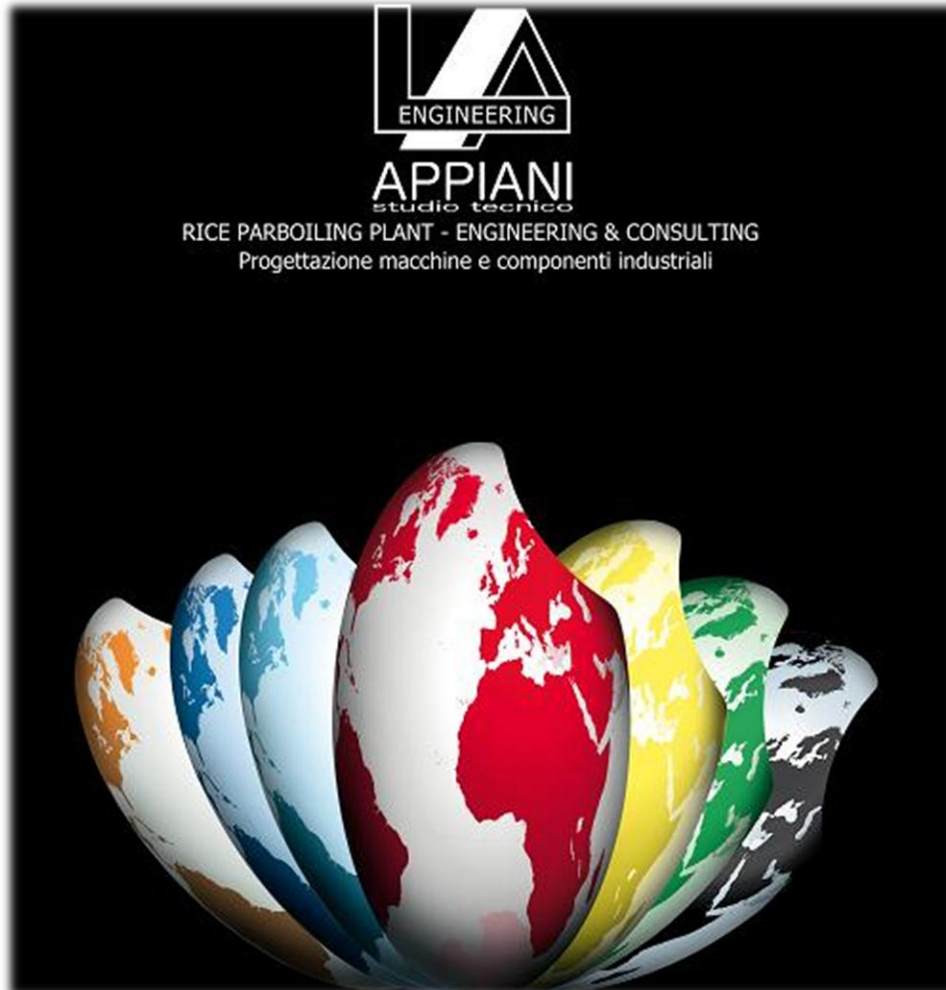
Economical

Due to its special processing, parboiled rice absorbs more water than conventional white rice and is particularly economic. And rice is an absolute bargain in comparison to other side dishes.

- The world consumption of parboiled rice is growing due to changing preparation and eating habits
- The most important improvements to the existing technology are:
 - Cleaning
 - Gravity separator and thickness grader
 - Regular change of soaking water
 - Water treatment plant for drinking water
 - Pressurized cooking
 - Waste water processing
 - Heat exchanger for drying
 - Uniform drying with good tempering

Parboiling

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Leading in modern Parboiling

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