

UTILISATION OF PLATE TECHNOLOGY FOR PREPARATION OF PLANTS FOR MAXIMIZED ENERGY RECOVERY

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The use of efficient heat transfer equipment is an essential requirement for the maximized recovery of low grade energy that is available in a crushing plant. The plate exchanger technology for use in bulk solids lends itself to this purpose by allowing for a larger heat transfer area without requiring a larger footprint or space. The paper explores the science behind accurate thermal modeling that is required to achieve an accurate temperature profile for the beans and/or seeds passing through a bank of heat exchanger plates. A heat transfer model in a slow moving bed of bulk solids requires a three dimensional Fourier series calculation based on thermal conductivity. It differs vastly from conventional use of U values to evaluate heat exchanger performance. The paper discusses options to quantify the overall energy savings in operating a soybean crushing plant by utilizing new sources of low grade waste heat or even improving the efficiency of waste heat recovering systems in place. The paper will also cover a comparison with traditional equipment used as pre-heaters and conditioners in an oilseed crush plant.

UTILISATION OF PLATE TECHNOLOGY IN OILSEEDS PREPARATION PLANTS FOR MAXIMIZED ENERGY RECOVERY

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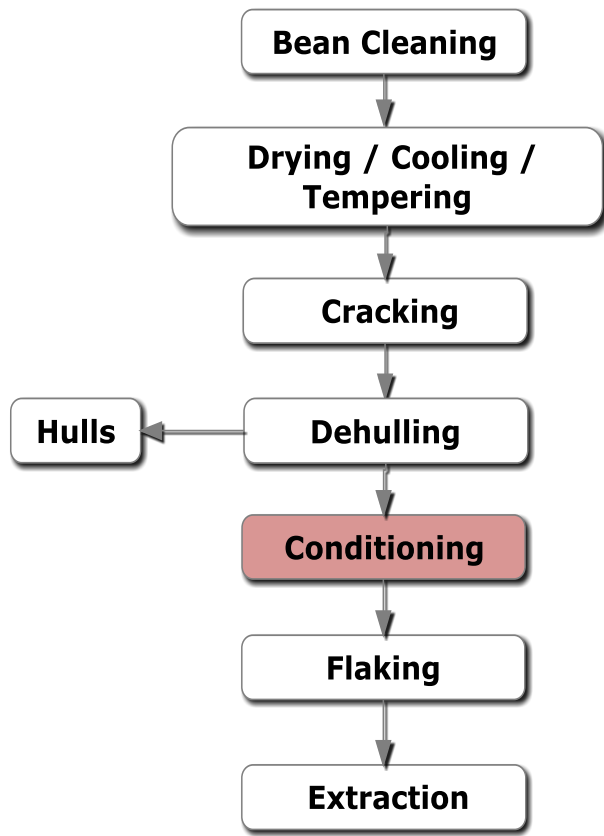
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Topics

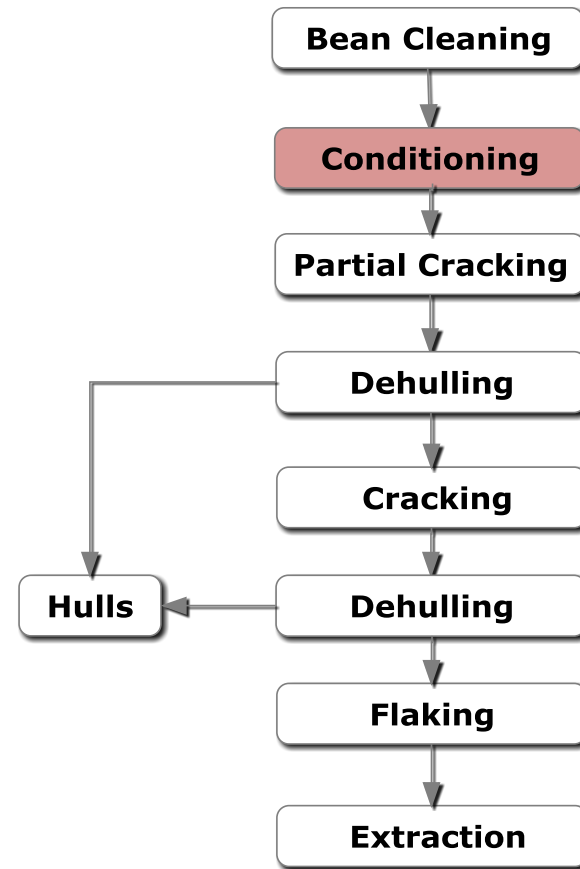
1. Soybean Processing – Conventional Technologies for Drying/conditioning
2. Indirect Heat Transfer
 - a) Efficiency comparison
 - b) Design features
 - c) Waste heat recovery options
3. Hot De-hulling & Cold De-hulling – Energy savings
4. Plate Heat Exchanger Advantage Summary
4. Questions

Soybean Processing

Cold Dehulling

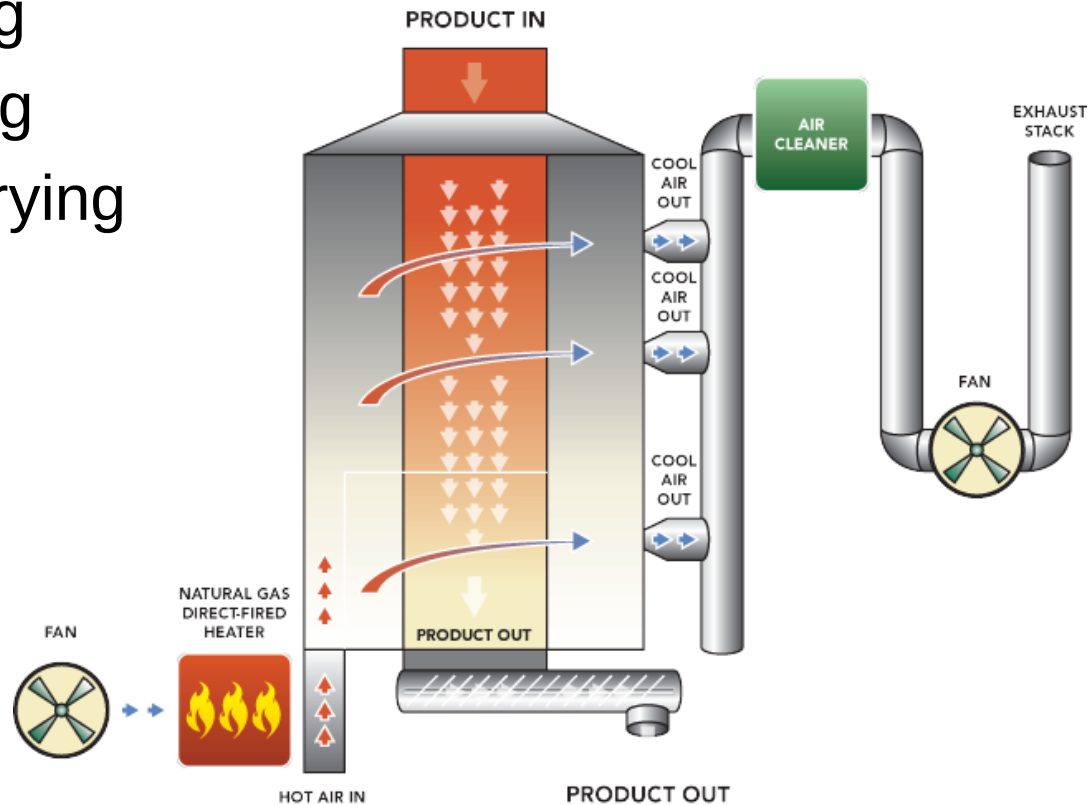


Hot Dehulling



Conventional Technologies

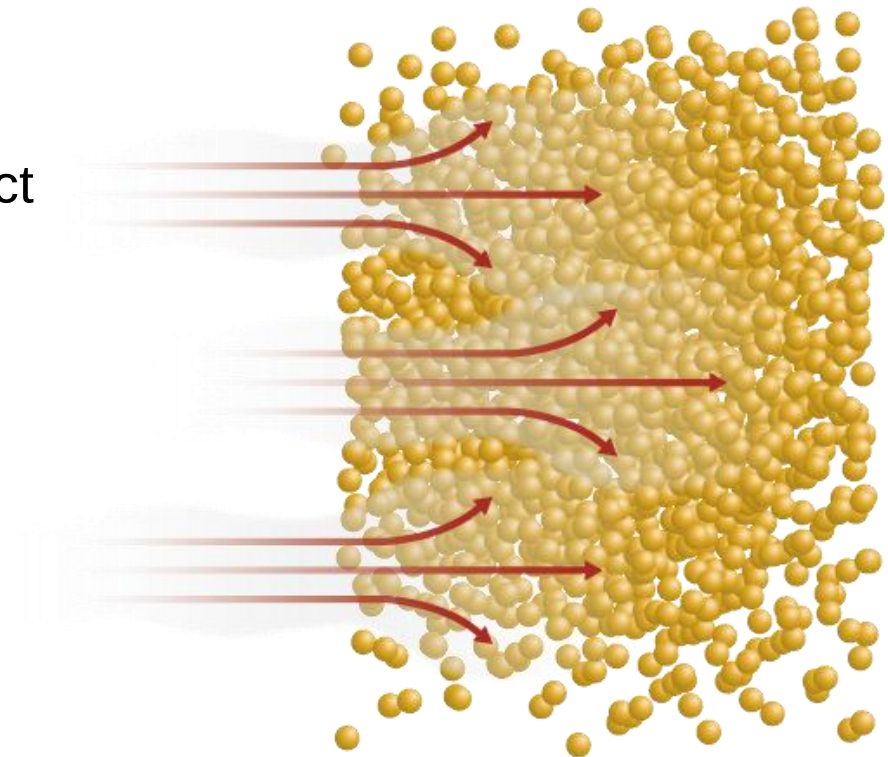
- Direct Air Drying
- Fluid Bed Drying
- Rotary Drum Drying
- Others
 - Flash Drying



Conventional Technologies

PRINCIPLE OF OPERATION

- Blow hot air across the product



Conventional Technologies

HOW IT WORKS:

1. Unsaturated air has moisture carrying capacity
2. Hot air has greater moisture carrying capacity
3. Blowing hot air across product serves two purposes:
 - a) *Heats the product*
 - b) *Removes moisture from product*

Typical efficiency: 30- 65%

Simple. Yet highly inefficient.

Conventional Technologies

INHERENT INEFFICIENCIES

1. Typical efficiency: 30-65%
2. Requires processing of very large quantities of air
3. Results in high stack losses
4. Larger fans are required
5. High power consumption

Solution – Indirect Heat

Thermal efficiency >90%

Efficient heat recovery

Dramatically increases the moisture carrying capacity of the air.

Minimizes the required air for moisture removal.

Temperature Profile through Exchanger

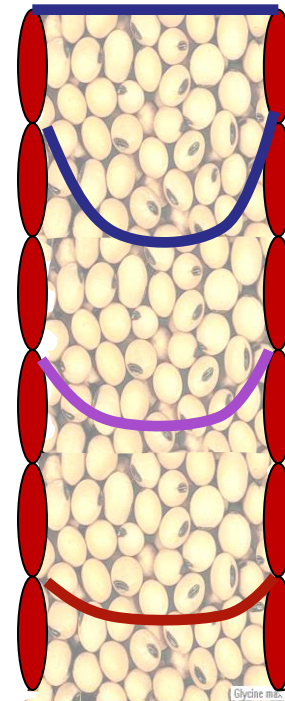


Plate Heat Exchangers for Solids

Level Control

Maintains product level above the plate bank

Models available to suit the application

Vertical Plates

Satisfy the required surface area for heat exchange

Can be accessed/removed/replaced individually

Discharge Feeder

Maintain mass flow of the product

Models available to suit the application



Plate Heat Exchangers -Efficiency Advantages

- Direct Air Heating
35-65 % efficiency
- Plate Heat Exchangers
> 90 % efficiency

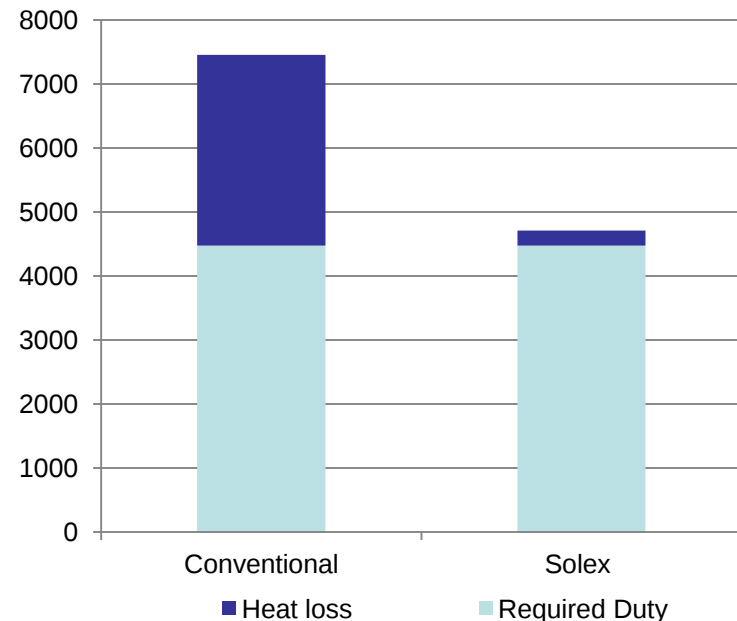
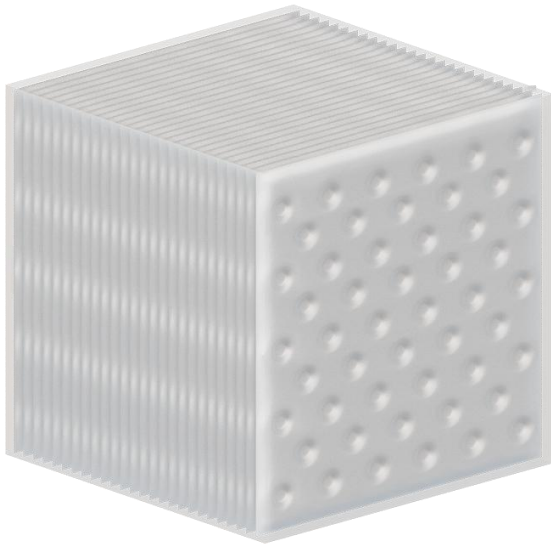


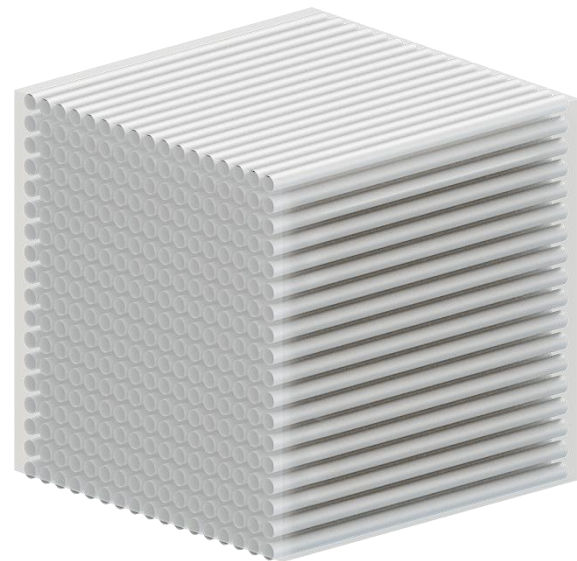
Plate Technology Makes the Use of Low Grade Heat Possible

- Increased the heat transfer surface area



PLATES

Heat transfer surface area: **50m²**
per 1m³ of volume.



TUBES

Heat transfer surface area: **24.5m²**
per 1m³ of volume.

Conditioner With Energy Recovery

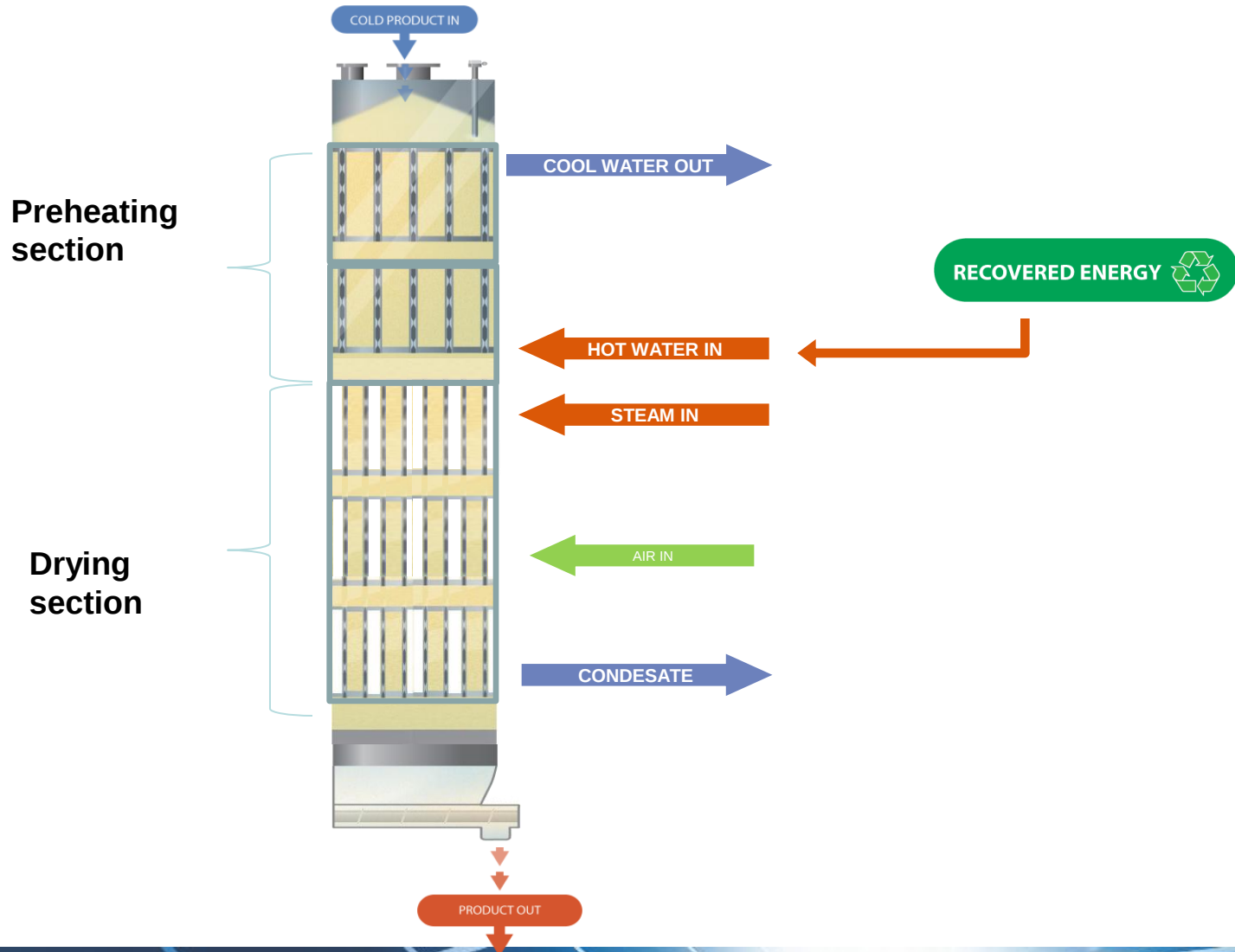


Plate Heat Exchangers -Efficiency Advantages

1. Product is heated indirectly
2. Air acts only as the carrying medium to remove moisture

(only a small amount of air is required)

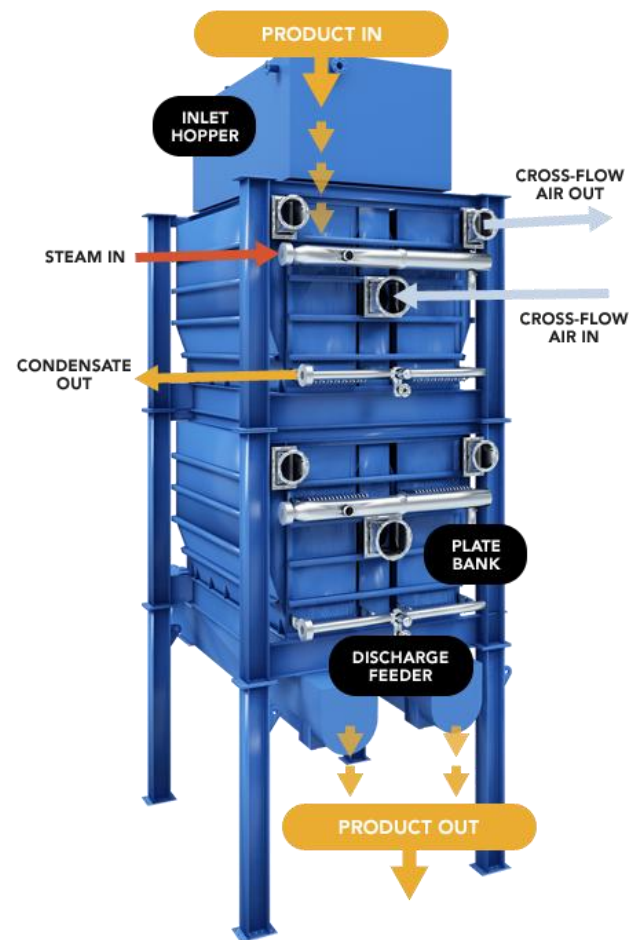
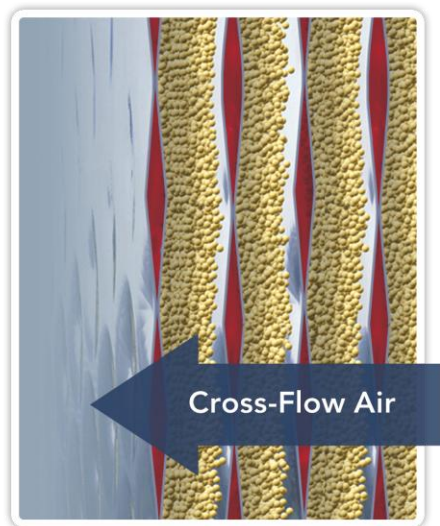
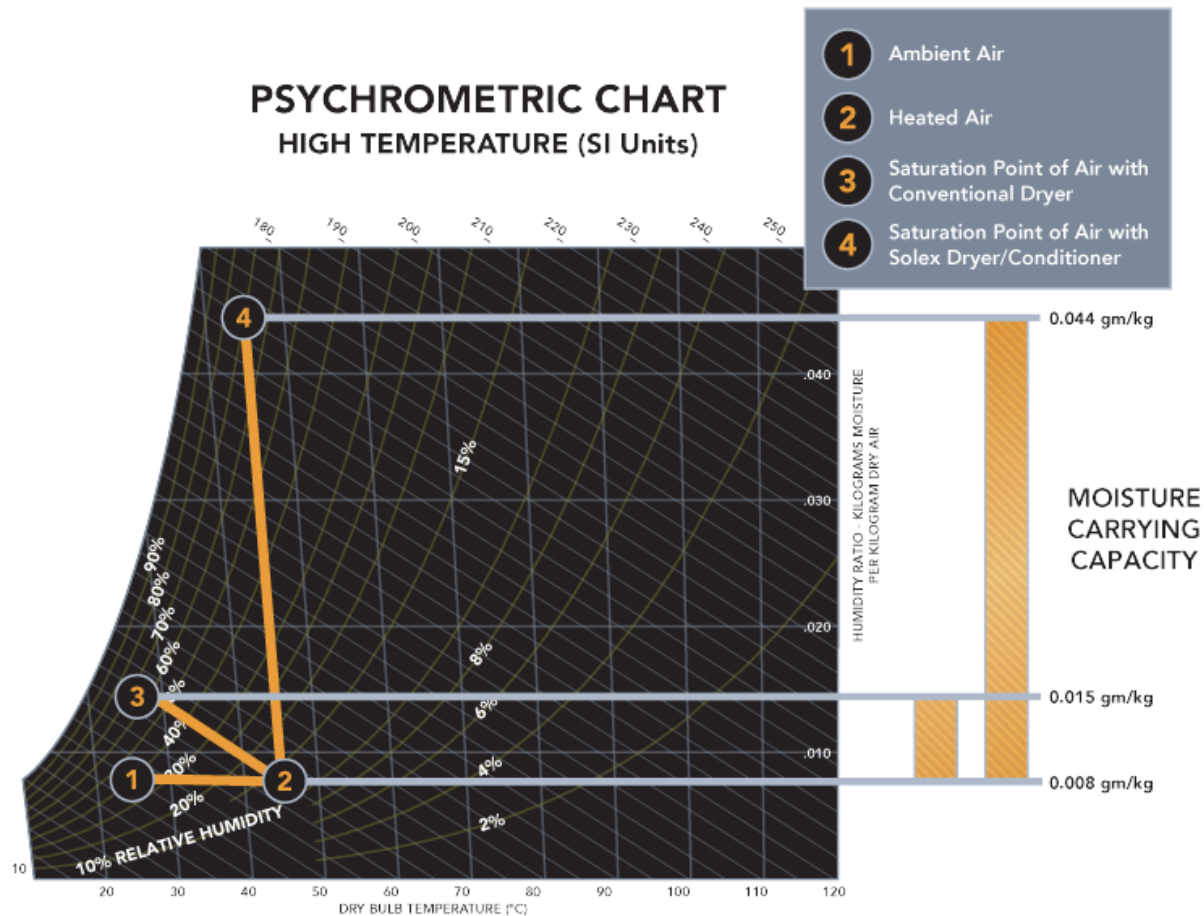
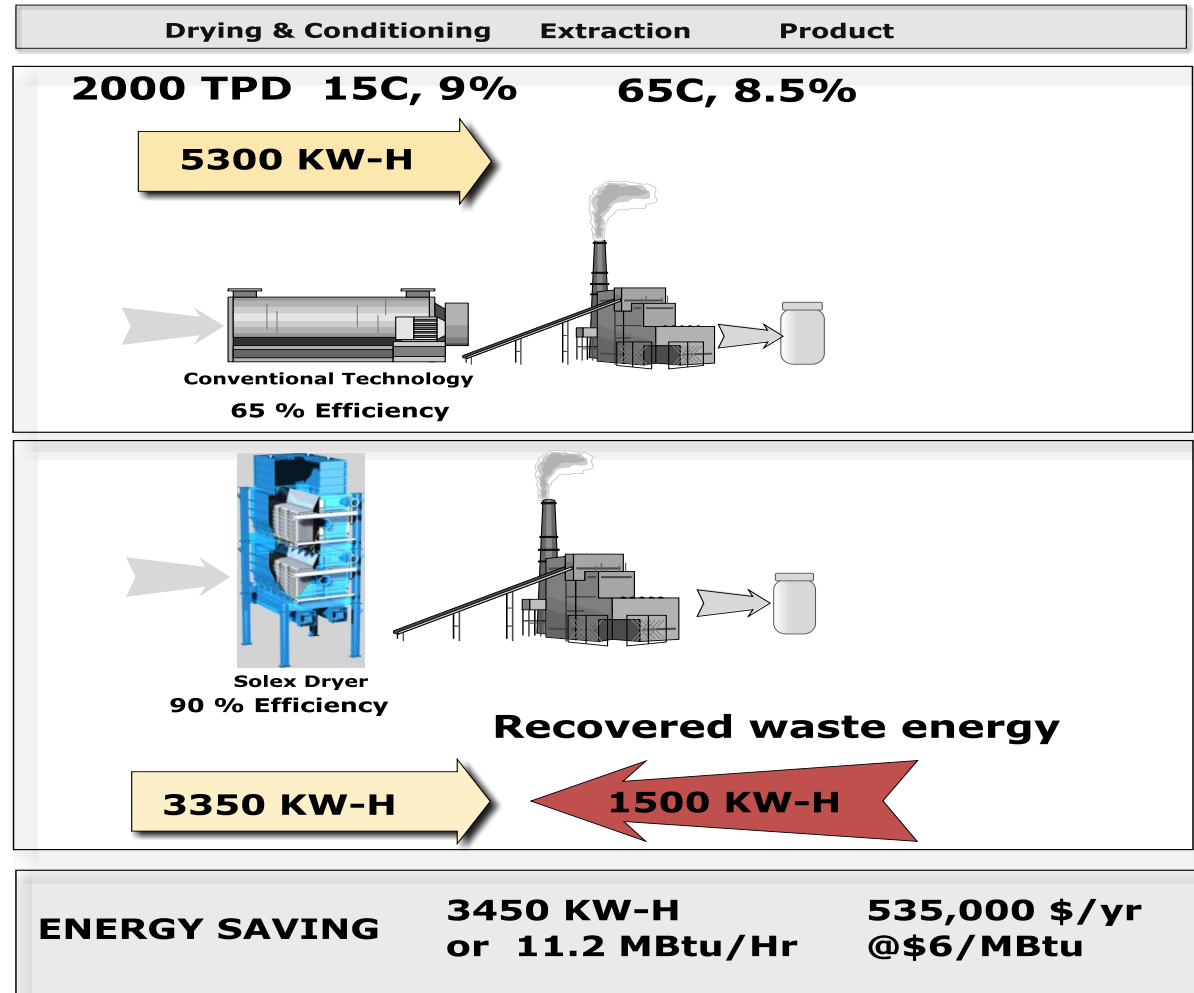
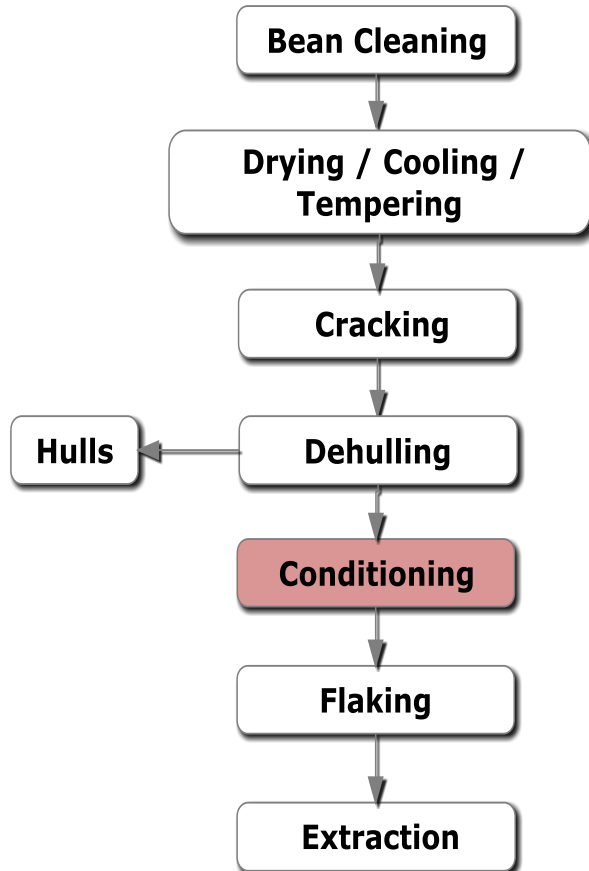


Plate Heat Exchangers -Efficiency Advantages



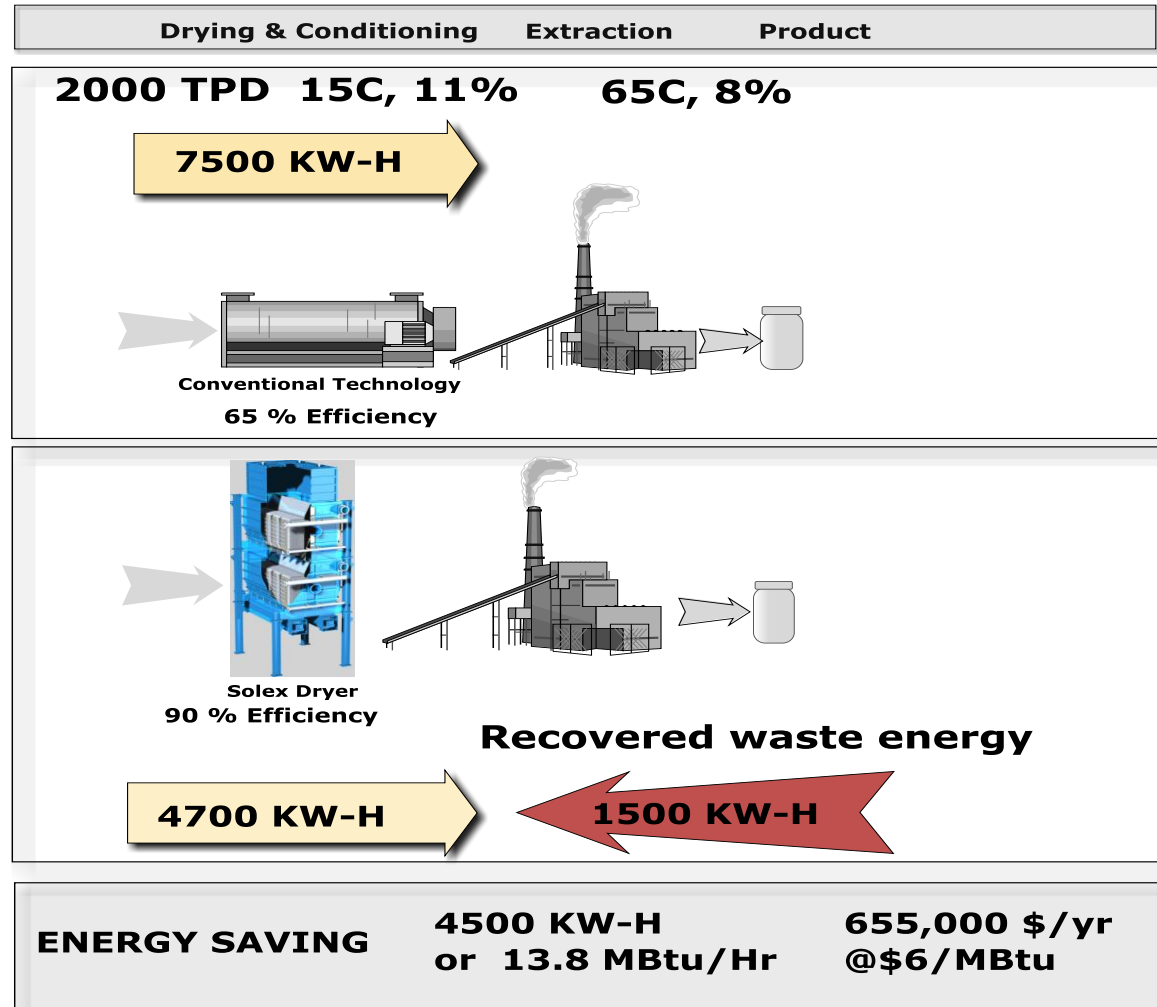
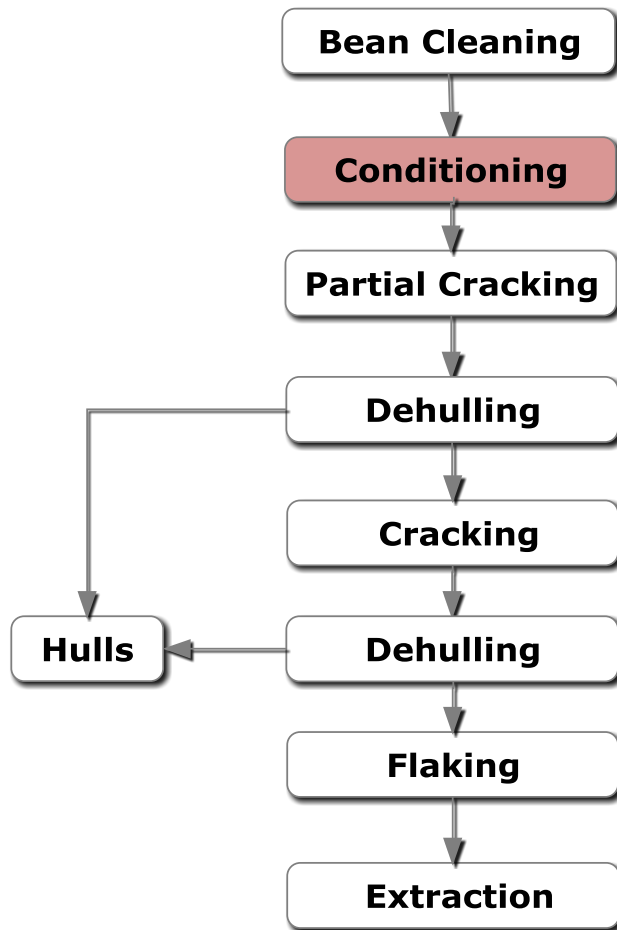
Energy Savings

Cold Dehulling



Energy Savings

Hot Dehulling



Flexible Operation

- Run each bank individually on different heat source
- Independent control of Temperature and Moisture



STEAM Hot Water Hot Water Hot Water



STEAM STEAM Hot Water Hot Water



STEAM STEAM STEAM Hot Water

Accessibility

Manifold and Flexible Connections

- Flexible stainless steel hoses allow for thermal expansion
- Individual threaded connections allow for plate removal
- All connections are outside the product stream

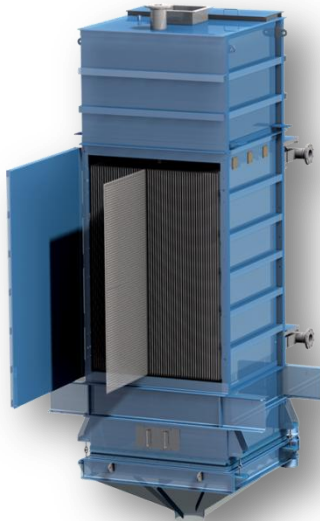
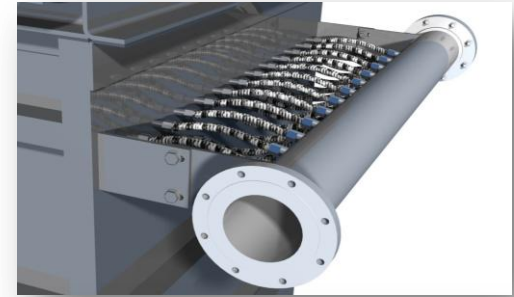
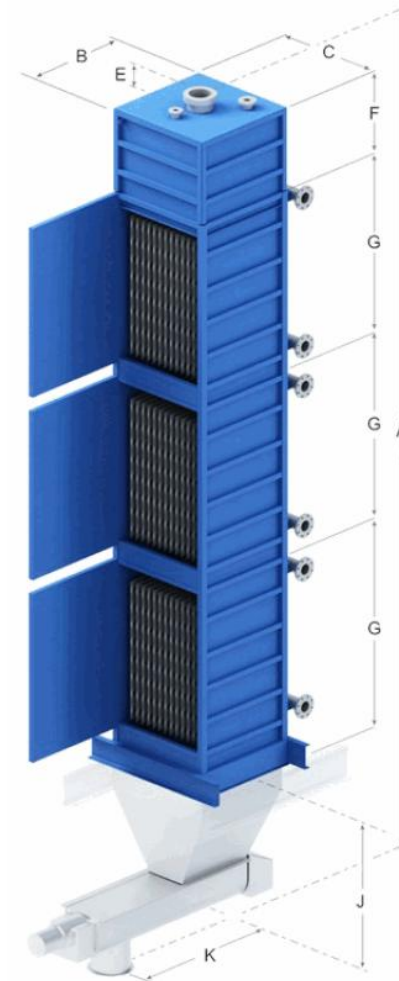


Plate banks inspection and Maintenance

- Easy access for cleaning and inspection purposes
- Plates can be individually removed
- Additional doors can be fitted

Reduced Installation, Operational and Maintenance Costs

- Absence of moving parts
- Smaller footprint
- Efficient heat transfer



Soybean Conditioner Technology Comparison

Feature Comparison			
	Fluid Bed Technology	Rotary Drum	Plate Heat Exchanger
Energy Consumption	High	Medium	Low
Installed Capital Cost	High	High	Low
Maintenance / Wear	High	Medium	Low
Modular Construction	Difficult expansion	Difficult expansion	Easy expansion
Compactness	Low	Medium	High
Air Required / Emission	High	Low	Low

Questions