Desmet Ballestra,
a leader in oil extraction technologies

Oils & Fats

desmet ballestra

Science behind Technology

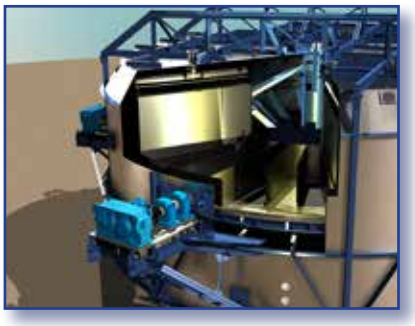
www.desmetballestra.com

Solvent Extraction

The seed, having been properly prepared, is separated into a crude oil fraction and a protein meal fraction by solvent extraction. The extractor utilizes a countercurrent, multi-stage washing with commercial hexane solvent to enable a reasonable quantity of solvent to extract a maximum quantity of oil. After washing, the solvent-laden meal drains by gravity and then discharges to meal desolventising. After washing, the oil/solvent mixture, commonly referred to as “miscella”, discharges to distillation.

According to your specific needs, Desmet Ballestra provides a complete range of extractors.

The Reflex® Extractor



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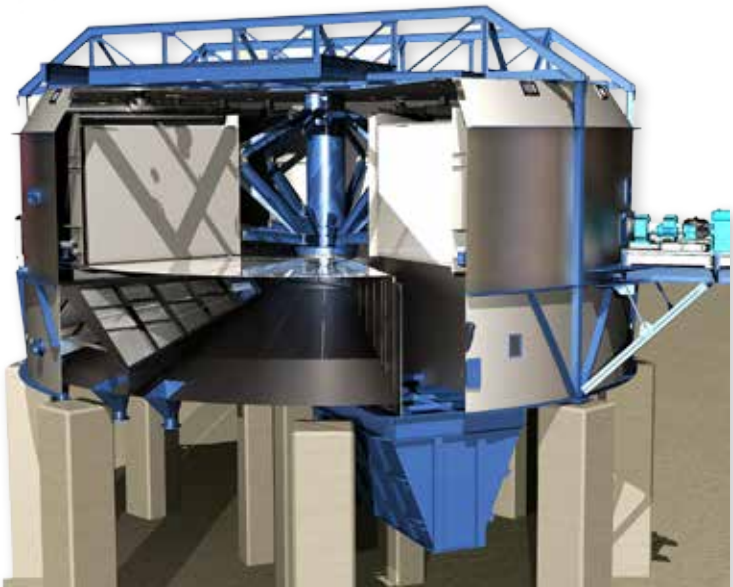

Advantages

Low Upstream Energy Demand *[when Soya only]*

- 15% less upstream flaking energy than shallow material layer extractors require

High Extraction Efficiency

- 50% of oil is washed out during the slurry filling process
- 100% miscella/material contact by full immersion in miscella between dividing walls
- Complete separation of miscella concentrations by dividing walls
- Online adjustment of miscella staging for varying material percolation rates
- Self-cleaning miscella spray nozzles insure even miscella distribution

Low Downstream Energy Demand

- 10-15 minute drip time provides 26-30% solvent retention
- 30% open area extractor screen provides 26-30% solvent retention
- 304 SS self cleaning extractor screen provides 26-30% solvent retention
- 2 mm wide slots in extractor screen provides 26-30% solvent retention

Low Maintenance

- 80% less drive energy than shallow bed extractors provides lowest wear
- Bevel gear drive – no chains – leads to minimum maintenance
- 304 SS extractor, low friction screen lasts the full life of the extractor

Low Solvent Loss

- Plug seal screw conveyor feed insures minimum air intake to the process
- Only one shell penetration for driving extractor minimizes fugitive solvent loss

Other Advantages

- Internal miscella filter insures industry's cleanest miscella, < 0.1% solids
- Edible oil lubricated bottom bearing prevents mineral contamination of oil
- Miscella hoppers run empty and stay clean of material fines

The LM™ Extractor

High Extraction Efficiency

- Long extraction time insures thorough miscella/material contact
- Excellent miscella/material contact via full immersion in early extraction stages
- Upward sloped material layer insures countercurrent miscella flow
- Separation of miscella concentrations by rakes between miscella stages
- Online adjustment of miscella staging for varying material percolation rates

Low Downstream Energy Demand

- 15 minute drip time provides 26-28% solvent retention
- 30% open area extractor screen provides 26-28% solvent retention
- 304 SS self-cleaning extractor screen provides 26-28% solvent retention
- Uniform material discharge via scraper insures uniform DT steam consumption

Low Maintenance

- 304 SS extractor screen with no friction lasts the full life of the extractor
- 304 SS roof minimizes corrosion
- 304 SS shell minimizes corrosion [when Rape only]

Other Advantages

- Linear design allows for maximum workshop assembly & ease of transport

The LLL® Extractor

High Extraction Efficiency

- Maximum percolation rates due to minimum layer depth and material compression
- Renewed percolation rates midway through extraction due to material layer reforming
- Fastest extraction due to acceptance of thinner upstream flaking
- Upward sloped layer insures countercurrent miscella flow
- 10-16 extraction stages maximizes the countercurrent effect
- Improved miscella sprayers for uniform miscella distribution
- Online adjustment of miscella staging for varying material percolation rates
- More tolerant of poor material percolation rates from fines or surface moisture

Low Downstream Energy Demand

- Shallow layer minimizes dripping depth and provides 26-30% solvent retention
- Uniform material discharge insures uniform DT steam consumption

Low Maintenance

- Chain paddles never slide on screen floor
- Material does not pass through elbow while chain rollers are turning
- Dual sided drive minimizes fatigue in housing and drive shaft
- No discharge hopper and screw to maintain

Other Advantages

- Bolted linear design allows for ease of transport
- Bolted linear design allows for minimum hot-work installation time

Roll-Ex, the Rolling Extractor

Specially designed for small capacities and special products

Advantages

- Set up time in hours !
- No pumps, no pipes
- No chains no sprockets
- No mobile parts inside
- Excellent with low percolating products
- Reduced electrical comsumption
- Excellent quality /price ratio

Practical - Simple

- Installation in 1 day
- Intense product/liquid contact
- Accepts products with low percolation rates
- Minimum electrical consumption

DIMAX™ Desolventising Process

The solvent-laden meal exiting the extractor contains 26-30% solvent by weight. The purpose of the desolventising process is to remove the solvent from the solvent-laden meal, toast the meal to control anti-nutritional factors, and reduce the moisture and temperature of the meal to levels appropriate for storage and transport. The majority of the heat supplied for evaporating the solvent from the meal is supplied from the latent heat of condensing live steam, which simultaneously increases the meal moisture to facilitate toasting. The drying and cooling of the meal are accomplished via passing air through a fluidized bed of meal. The solvent and water vapours exiting the desolventising process pass through a scrubber to remove meal particles before passing on to distillation for heat recovery.

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Advantages

High Desolventising Efficiency for Low Solvent Loss

- 10% open area countercurrent DT trays allow optimized steam contact rising through meal layers supported above
- Aerodynamic sweep arms insure minimum disturbance of rising stripping steam through meal layers
- Rotary valves insure uniform steam distribution by creating a seal between trays to eliminate steam the short-circuiting that occurs in DTs with chutes
- High steam density insures steam adequately strips solvent from all meal particles

Low Desolventising Energy

- 71°C dome temperature provides 92% solvent content in exhaust vapours
- Flash steam tray recovers flash water vapour heat
- High steam density minimizes meal stirring electrical power
- Slow sweep arm rotational speed minimizes meal stirring electrical power

Low Meal Drying & Cooling Energy

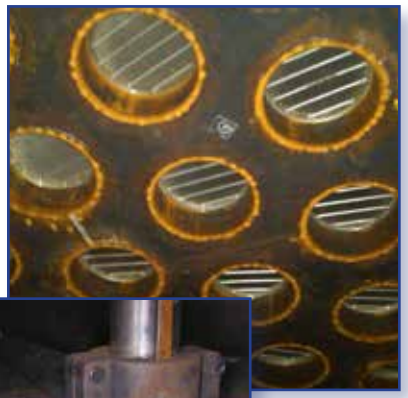
- Drying air heat recovery from Stripper Precondenser
- Drying air heat recovery from low pressure steam condensate

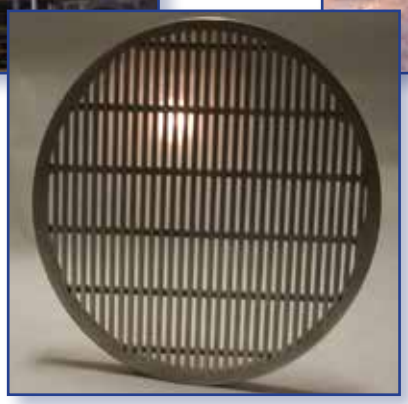
Maximum Uptime

- Thorougly scrubbed DT vapours insure clean downstream First Stage Evaporator, minimizing fouling and the need for cleaning
- DT main speed reducer with minimum 2.0 service factor for years of lasting service

Other Advantages

- Vapour Scrubber with hydraulic seal to safely avert high DT pressure during upsets
- Vapour Scrubber with caustic option to minimize plant corrosion
- Dryer Cooler designed for minimum salmonella contamination





Patented Dimax screen trays provide 10% rising steam redistribution area to insure optimum steam/meal contact.

Miscella Distillation

The oil/solvent mixture leaving the solvent extractor is commonly referred to in the industry as “miscella”. The miscella leaving the solvent extractor contains 70-80% solvent by weight. The purpose of distillation is to thermally separate the miscella into a liquid oil fraction and solvent vapour fraction. The energy efficiency of distillation is maximized through optimum use of the available heat in the discharge vapour stream from the Desolventiser Toaster, available heat from the condensate flash tank, and heat recovery within distillation itself. Desmet Ballestra optimizes the sizing and design of the distillation equipment with its state-of-the-art OptiSim™ software tools to achieve optimum efficiency.

Advantages

Uniform Miscella Flow to Save Steam

- Ample sized Miscella Tank to act as a buffer after Extractor to insure smooth flow through distillation and therefore minimize Second Stage Evaporator steam

Maximum Heat Recovery to Save Steam

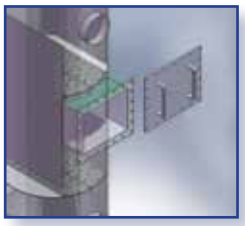
- 30% larger surface area First Stage Evaporator to enable maximum heat recovery of DT exhaust vapours to minimize Second Stage Evaporator steam
- Use of recovered flash steam in Second Stage Evaporator to minimize fresh steam
- Oil Dryer Steam Ejector exhaust recovered in Oil Stripper
- Miscella/Oil Heat Exchanger to recover heat from hot oil to minimize Second Stage Evaporator steam

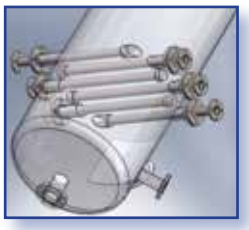
Ideal Oil Stripping Efficiency

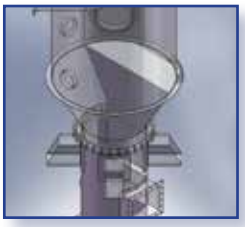
- 75% lower residual solvent in oil due to maximized steam/oil contact in the improved sieve-tray type Oil Stripper versus conventional disc/donut designs
- 15°C lower miscella temperature required which saves Second Stage Evaporator steam and reduces degradation of the crude oil prior to oil refining

Maximum Uptime

- 3-pass Seond Stage Evaporator design enables fast miscella tube velocity and minimizes tube fouling and cleaning frequency







Solvent Recovery

Solvent vapours mixed with air depart the extractor, solvent vapours mixed with water vapour depart distillation, and a mixed water/solvent liquid stream departs distillation. The purpose of solvent recovery is to condense the solvent vapour and water vapour, then physically separate the liquid water from the liquid solvent such that the solvent can be recycled back to the extractor, and the waste water can be safely discharged from the plant. Desmet Ballestra optimizes the sizing and design of the solvent recovery equipment with its state-of-the-art OptiSim™ software tools to achieve optimum efficiency.

For rapeseed and sunflower

Advantages

Maximum Heat Recovery to Save Steam

- Countercurrent, split flow Vacuum Condenser maximizes vacuum to enable maximum heat recovery of DT exhaust vapours in the First Stage Evaporator
- Stripper Precondenser enables heat recovery of stripper exhaust vapours to heat solvent before going to the Solvent Heater
- Vacuum Condenser Steam Ejector exhaust vapour heat is fully recovered in the Waste Water Stripper

Ideal Solvent/Water Separation to Enhance Extractor Efficiency

- Emulsions prevented via no Vacuum Condenser Pump to emulsify entrained oil
- Solvent/Water Separator with laminar flow sieve plates to speed separation
- Solvent Cyclone to insure water droplets are removed from solvent

Low Solvent Loss

- Square tube pitch in condensers to minimize pressure during upset conditions
- Efficient two-stage Waste Water Stripper to minimize solvent in water effluent

Simplicity

- Only one pump required, to pump solvent to the extractor

For soya

Advantages

Maximum Heat Recovery to Save Steam

- Countercurrent, split flow vacuum condenser maximizes vacuum to enable maximum heat recovery of DT exhaust vapours in the First Stage Evaporator
- Stripper Precondenser enables heat recovery of stripper exhaust vapours to heat the drying air entering the meal Dryer Cooler
- Solvent Preheater enables heat recovery of excess DT exhaust vapours to heat solvent prior to the Solvent Heater
- Vacuum Condenser Steam Ejector exhaust vapour heat is fully recovered in the Waste Water Stripper

Ideal Solvent/Water Separation to Enhance Extractor Efficiency

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Simplicity

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Mineral Oil System

The effluent air leaving solvent recovery contains an equilibrium concentration of solvent in the range of 50-70% by weight, dependent upon vapour temperature. The purpose of the mineral oil system is to absorb the residual solvent out of this effluent air stream to less than 1% by weight of solvent before it is safely discharged to atmosphere. The solvent absorption takes place into cool mineral oil. After absorbing the solvent, the cool mineral oil is heated and then the solvent is steam stripped out of the mineral oil under vacuum. The hot, stripped mineral oil is then cooled and circulated back for absorption, forming a closed loop mineral oil system.

Advantages

Optimised Solvent Vapour Absorbing Efficiency

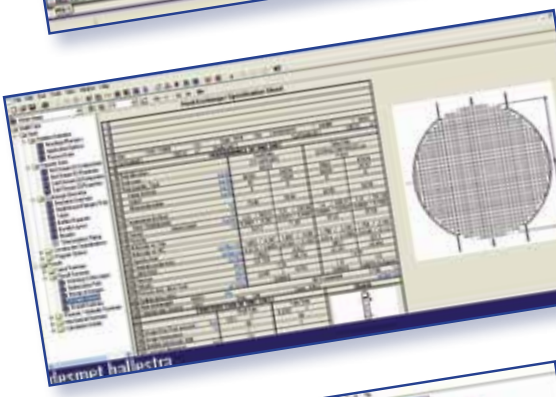
- Only 5-20 g/m^3 of solvent left in effluent air
- 8-10 meter tall packing section for optimised oil/vapour contact
- Stainless steel pall ring packing for optimised oil/vapour contact
- Cool 20°C vapour entering minimizes packed column loading
- Cool 23°C mineral oil entering maximizes absorbtion of solvent
- Only 0.1% M&V in mineral oil entering Solvent Vapour Absorber
- Only 2% M&V in mineral oil leaving Solvent Vapour Absorber

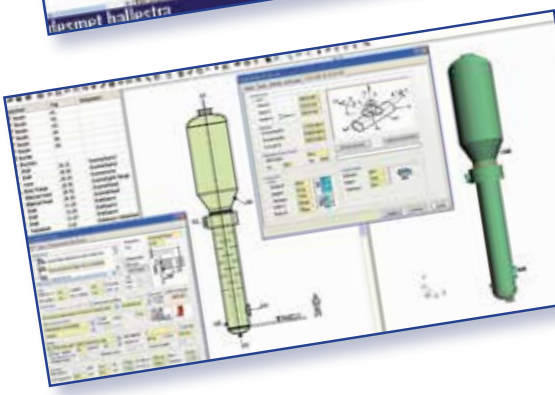
Optimised Mineral Oil Stripping Efficiency

- Mineral Oil Stripper under vacuum to minimize solvent in recirculated mineral oil
- 2-stage Mineral Oil Stripper with flash section plus packed column section
- Entrainment separator to minimize mineral oil losses and contamination of edible oil
- Mineral Oil Stripper under vacuum to eliminate water draining required with atmospheric systems

Minimized Solvent Losses During Upsets

- Final Vent Cooler with chilled water minimizes remaining solvent in vapour stream, even during an upset vapour load
- Ample recirculated mineral oil flow rate allows for much higher absorbtion rates during an upset vapour load





Waste Water Steam Generation

The waste water leaving the solvent extraction process typically goes to the waste water sump, and then to a water treatment facility. In those oilseed processing plants with limited waste water treatment capacity, and/or limited fresh water availability for creating boiler steam, a waste water steam generation system can be applied. The waste water steam generation system evaporates the vast majority of the waste water from the solvent extraction process into low pressure steam for re-use in meal desolventising, and the remaining small stream of hot water concentrate is sprayed onto the desolventised meal.

Advantages

Minimum Effluent

- 100% of process waste water can be recycled
- 95-97% of process waste water is converted to direct steam used in the DT
- 3-5% purge of process waste water is sprayed as hot water on meal in the DT

Minimum Fresh Water Demand

- Condensate return to the boiler is maximized
- 67% reduction in solvent extraction make-up water demand at the boiler

High Quality Steam

- Steam Superheater insures wet steam is converted to a slightly superheated quality, ideal for DT operation

Heat Recovery

- Superheated steam condensate from Waste Water Evaporator is used to pre-heat the feed water to the Waste Water Steam Generation system
- Remaining superheat in the steam condensate is used to heat the drying air entering the meal Dryer Cooler

High Uptime

- Pre-heated feed water and 20:1 recirculation rate insure high water velocity in the Waste Water Evaporator to minimize tube fouling and downtime required for cleaning

Degumming Solutions

Water degumming

The crude oil from the solvent extraction process contains water soluble components, primarily comprised of phospholipids, which need to be removed from the oil to enable minimum precipitation and settling during oil transport and long term storage. The water degumming process involves adding water to the crude oil, hydrating the water soluble components, and then removing the majority of them via centrifugal separation. The light phase after centrifugal separation is the crude degummed oil, and the heavy phase after centrifugal separation is a combination of water, water soluble components and entrained oil, collectively referred to as "gums". The crude degummed oil is dried and cooled before being sent to storage. The gums can be pumped back onto the meal.

Advantages

Simplistic

- Surge tank to prevent brief degumming interruptions from stopping extraction
- No oil heating or cooling prior to Degumming Separator
- Utilizes same Oil Dryer as the solvent extraction distillation process
- Utilizes condensate from extraction for hydration water source

Effective

- Consistently produces degummed oil with less than 200 ppm phosphorus
- Hydration Vessel has multiple internal agitated compartments to optimize hydration
- Positive displacement pump minimizes disturbance of hydrated gums

High Uptime

- Automated self-cleaning centrifuge minimizes break-overs and operator interface

Enzymatic water degumming

Purifine® phospholipase C enzyme (supplied by DSM) is added to the crude oil during the degumming operation to enhance oil yield. This enzyme selectively splits the phosphatidyl choline and phosphatidyl ethanolamine type phospholipids into a diglyceride and a phosphorus containing molecule. The diglyceride directly becomes a portion of the oil yield. The reduced phospholipid content to the centrifugal separator reduces the quantity of entrained oil with the gums. This dual impact increases oil yield in the range of 1-2% during degumming.

Advantages

Maximized Yield

- 1-2% higher yield when compared to traditional water degumming
- Majority of phospholipids converted to diglyceride oil
- Less total gums results in less separator oil losses

Minimum Enzyme Consumption

- Approximately 1 ppm enzyme per 6 ppm of phosphorus
- Crude Oil Cooler to adjust temperature for maximum enzyme activity
- High shear mixing for optimum enzyme/water distribution into the oil
- 2 hours reaction time via plug-flow, multi-compartment, stirred Enzyme Reactors
- Crude Oil Heater to deactivate enzyme and optimise gums separation
- Mass flow meters and auto-samplers to monitor performance

Higher Protein Meal

- Reduced gums quantity reduces dilution of meal protein

Unique Extraction Expertise

Process control

Process automation

Advantages

Easy management

- Whatever the size of the plant, the various processes used in extraction are easy to manage today, thanks to the rational approach offered by computers and programmable logic controllers.

Reduction of risks

- Automation serves various purposes, including the reduction of risks attributable to human mistakes, achieving a better and constant quality, superior yields, reduced solvent & steam consumption, and a higher degree of safety.

Any framework of any network

- The framework of automation networks – to which it is easy to add other digital systems - is so flexible that numerous solutions exist, for both new and old plants.
- These networks do meet the requirements of all the processes used today.

Centralised Supervision

Advantages

Permanent follow up

- Centralised supervision is the most efficient tool to permanently follow production.

Overall view

- The method, using selected softwares, continually offers an overall view of the ongoing activities and of their historical account.

Reports

- - Analogic reports
  - Reports on variables
  - Preventive maintenancereports
  - Production reports: flowrates, quality controls, etc.
- Easy to analyze, these reports are the undeniable witness of the complete activity of a process.

No data unattented

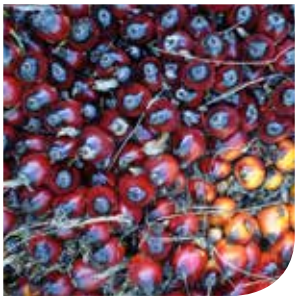
- Central supervision is the ultimate management tool that leaves no data unattented.

Desmet Ballestra's extraction solutions
Main applications









Cashew nut
Castor seed
Cocoa
Copra
Corn
Cotton seed
Fish oil
Grape seed
Groundnut
Jojoba
Lard
Linseed
Mustardseed
Olive
Palm
Palm kernel
Rapeseed (Canola)
Ricebran
Safflower
Salseed
Sesame seed
Sheanut
Soyabean
Sunflower
Tallow
Tung

Desmet Ballestra Oils & Fats has contributed to the success of numerous industrial projects through the supply of thousands of process sections in over 150 countries.
To identify the right solution meeting your requirements, contact your local Desmet Ballestra office (all contacts on www.desmetballestra.com).

Oils & Fats

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