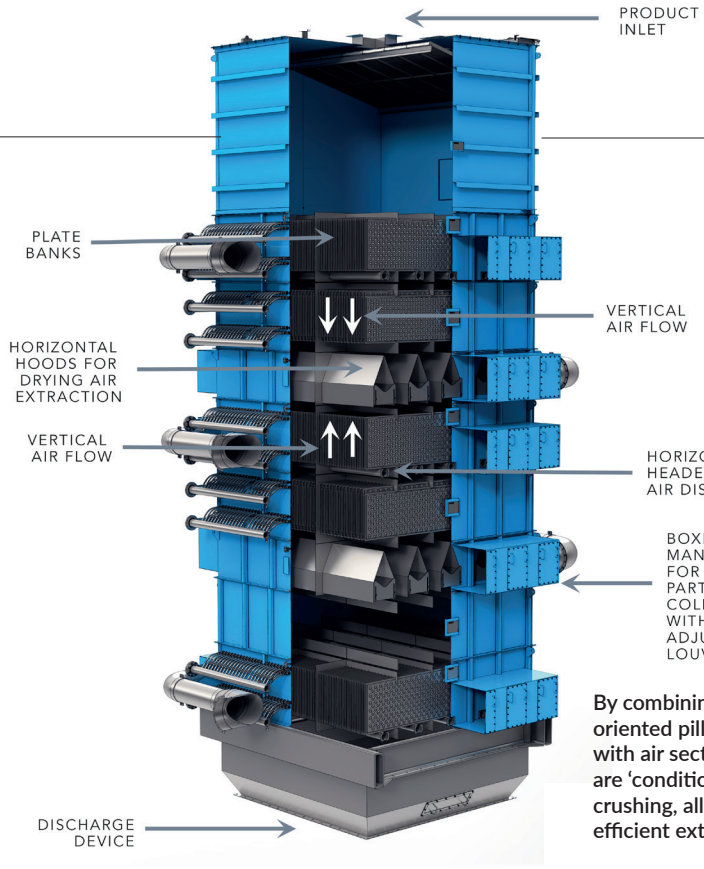
Sowing the seeds of innovation

Vertical plate conditioning allows oilseed processors to more efficiently use steam and adds a waste heat recovery loop, offering significant reductions in overall energy consumption

Jamie Zachary



By combining vertically oriented pillow plates with air sections, oilseeds are 'conditioned' before crushing, allowing for the efficient extraction of oils

Innovations in vertical plate conditioning technology are being praised by advocates as timely considering the developing needs of today's oilseed processors.

By combining vertically oriented pillow plates with air sections, oilseeds are "conditioned" prior to the crushing process, allowing for efficient extraction of the valuable oils, says Stan Pala, global sales director, oilseeds for Canada's Solex Thermal Science. The technology also provides a much-needed latchkey solution to reducing energy costs with improved productivity, he adds.

"The commodity prices of oil and meal are something processors are generally unable to influence directly. However, optimising processing operations is something that is in their control," says Pala, who leads the oilseeds division of the heat exchanger technology firm. "Plate technology provides oilseeds processors with the opportunity to make improvements that create a noticeable impact on their bottom lines."

They are also looking to increase crushing capabilities with minimal capital expenditure.

Meanwhile, increasing moisture levels in imported products are placing added stress on existing equipment. Solex global director of food products Pedro Moran notes crushing plants in Europe are seeing soyabeans from Latin America and canola from Canada, in particular, arriving at their plants with moisture levels that are 1-2% higher than what they are used to seeing.

"Because the existing equipment was designed to accommodate lower moisture levels, this creates processing issues, affects the final yield efficiency, as well as creating production bottlenecks that lead to significant losses," he says.

Aging equipment is also proving costly to maintain. Rotary and vertical seed conditioners often require significant tube replacement costs caused either by abrasion or cracking due to thermal stress.

Waste heat recovery

Yet it is steam consumption that is on the top of many oilseed processors' hit lists – or, to be more specific, reducing associated energy costs. Pala estimates steam accounts for about a quarter of total processing costs.

"There's an incredible economic motivation to re-using waste heat from elsewhere in the plant to reduce the overall steam demand, and thereby energy consumption in the preparation process," he says, adding this also can be connected to government incentives for energy savings and CO_2 emission reductions.

Most of the available waste heat for recovery exists as a by-product from different processes in the extraction stages. For example, the main sources of waste heat in a typical soyabean processing plant include:

- Flash stream or condensate from the extraction process
- Cooling of gas engines or gas turbines for efficient operation
- Vapours from dryer coolers (DC)
- Boiler flue gases — economiser
- Other sources from another process

For canola processing plants, typical sources of waste energy include:

- Vapours from the cooker
- Pressed and refined oil
- Condensate or flash steam
- Boiler flue gases
- Gas turbine or engine
- Other sources from another process

Most of this waste energy is low-grade heat – process heat that is usually discharged to the environment because its recovery and utilisation is not typically viable due to its low temperature (condensate around 90°C, hot oil in the 80-95°C range and vapours around 80°C).

"For the most efficient recovery, you need to minimise the temperature difference between the waste heat and the seeds," says Pala. "And to do so, you need a very large heat transfer area."

Vertical plate conditioners

Plate technology has the advantage of offering significantly more heat transfer area than tubes within the same space. An added bonus is its modular configuration that fits within most current oilseed plants.

A standard plate-style unit measuring 3.3m x 3.3m x 1m can offer about 420m^2 of heat transfer area, compared with about half for traditional tube heating technology.

The oilseeds flow by gravity between the plates with hot water, condensate or steam flowing counter-currently inside the plates to provide most of the heat load needed. Air sections allow air to be blown through the moving bed of seeds to remove the moisture that is released as the seeds are heated. At the bottom of the conditioner sits a discharge feeder that allows for uniform mass flow of seeds through the unit (*see diagram, above*).

The oilseeds' velocity through the heat exchanger is low – about 60cm/minute –

which helps to extend the lifetime of the plates due to almost no abrasion.

"The pillow plates are double-welded together, which allow for corrugation after expansion. This is necessary for efficient heat transfer by convection," says Pala, noting the double-weld design also protects the product from contamination. Independent flexible connections to the supply and discharge manifolds allow for thermal expansion without the risk of cracking.

"The profile of the plates also allows for the heating medium to make a certain number of internal passes to increase the velocity inside the plates, if needed. This means the plates can maintain the flow rates necessary for efficient heat transfer."

Steam savings

By more efficiently using steam and adding a waste heat recovery loop, plant operators can significantly reduce overall energy consumption.

"In the example of a soya plant with 125 tonnes/hour processing capacity, adding a single vertical plate conditioner (VPC) module with a waste heat stream at 90°C can reduce annual steam consumption by more than 10,000 tonnes," says Pala, noting the proprietary indirect plate heat exchange technology developed by Solex in these units has been around for more than 30 years.

If waste heat at only 70°C is available, steam savings of more than 5,000 tonnes/year are still possible.

"Given the above and assuming a steam cost of US$20/tonne, plants can expect to save more than US$100,000/year for each module they install – with standard VPCs containing multiple modules that will run on a combination of heat recovery and steam," says Pala.

In canola plants, steam requirements are high due to the cooking process, offering an even better opportunity for heat recovery. In a typical 2,000 tonnes/day plant, waste energy from cooker vapours (at 85°C and 90% moisture), hot oil (40-85°C) and sub-cooling of condensate (from 100-180°C) offer a combined steam savings of up to 60kg/tonne.

In many cases, the heating will be fully covered by the waste energy, and eventually only the bottom banks of the conditioner will run on steam if needed.

Additional advantages

The larger heat transfer area and modular design also mean vertical plate conditioning technology allows plants to seamlessly increase production capacity as it can often be installed in the same space as existing equipment.

Pala adds plates come with a lower total cost of ownership than tube technology. The gentle handling of seeds through the vertical exchangers minimises plate abrasion, leading to plates that typically last the lifetime of the conditioner – a minimum of 15 to 20 years.

Finding the sweet spot

Moran acknowledges that plants will have different considerations when looking at vertical plate conditioning technology. For example, as the need to recover more heat increases, so too does the required heat transfer area. At a certain size, however, the payback time becomes too long.

"It is important to find a sweet spot in terms of that ROI, as well as factor in other circumstances that influence the recovery rate such as seasonal conditions," says Moran, noting that Solex uses proprietary thermal modelling software to find the best solution. "Winter, for example, offers a much more efficient opportunity for heat recovery due to the incoming low seed temperature or the quality of the waste source (that is, saturation of the vapours from the DC)." ●

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