Low-temperature rendering for competitive advantage

RENDERTECH

Less energy.

Less odour.

Better products.

Higher profits.

After nearly 50 years of development, low-temperature rendering is a proven and high-performance solution for the rendering and protein recovery industry. Rendering plant owners in the 1980s were attracted by lower energy use. Today's owners still want lower energy use, but also want reduced odour and wastewater, and higher quality products.

In the following pages, we review the technology, the latest developments in the field, your options, and the outcomes and competitive advantages low-temperature rendering offers.

THE CHALLENGE

How to use less energy

Rendering is a recycling process where processing plants turn otherwise unusable animal parts into useful and high-value co-products in their own right.

An optimised rendering plant is therefore a crucial step in minimising the environmental impact of the sector as a whole, across the red meat, poultry and fish industries.

However, the process of transforming raw materials into usable products requires a lot of energy — 44% of the total energy consumed in a meat-processing plant according to a recent Australian study.[1]

When you do the numbers, this cumulative effect on big plants means even the smallest improvements can create significant savings.

The technical challenge therefore is how to reduce the energy needs of the separation and drying stages in the rendering process. And the insight is in understanding that the choice of rendering system has a huge impact on energy use. Selecting and installing the right process can save far more energy than trying to make the wrong process efficient.

[1]Tracy Colley, Energy savings calculator and energy allocation project (Meat & Livestock Australia Limited, 2008).

THE SOLUTION

Smarter technology

In the same way car manufacturers build and tune high-performance engines, rendering equipment manufacturers and engineers optimise their technology for continuous efficiency, better environmental outcomes and, ultimately, competitive advantage for plant owners.

Rendertech founder and director Steve Dunn helped pioneer low-temperature rendering in New Zealand in the late 1970s, and Rendertech engineers have continued to optimise low-temperature systems for ever-increasing gains in performance.

Not only is energy a major operational cost for rendering plants, but stronger government and public pressure to reduce carbon footprints and emissions also makes energy reduction a real focus for plant owners.

While energy savings were typically the major driver to transition over to a low-temperature system, the technology has a number of other knock-on effects with significant advantages:

Lower temperature means reduced odour.

Lower temperature means reduced wastewater loadings.

Lower temperature is gentler on raw materials.

For these reasons, plant owners find environmental compliance easier and more affordable, and get higher market prices for their tallow and protein meals.

A BRIEF HISTORY

The development of the technology

Energy audits of meat-processing facilities in the 1970s identified rendering as a major user of energy in the industry, and the process was closely scrutinised as a potential area for savings.

At that time, rendering systems were typically **high temperature** or **dry rendering** processes, either batch or continuous, that thermally removed the water through evaporation. These processes had high energy loads, and also exposed the end products (meal and tallow) to damaging high temperatures of over 130°C.

In high-temperature processes back then and today, the meal is effectively deep-fried in the tallow, which breaks down the proteins. The tallow is overheated in the presence of contaminates, which colours the tallow, reducing its quality and usability.

First advance:

MIRINZ low-temperature rendering process

Second advance:

press dewatering system

Third advance:

waste heat evaporators

First advance: the MIRINZ low-temperature rendering process

The research into low-temperature techniques in the 1970s was undertaken by the Meat Industry Research Institute of New Zealand (MIRINZ) and resulted in them developing the MIRINZ low-temperature rendering process.

This system heated the minced raw material to between 90 and 99°C in a rendering vessel to rupture the fat cells and coagulate the proteins. The liquid phase (fat and water) was then removed by a centrifuge decanter and further separated, before the tallow could be exposed to high heat. The solids were then sent for drying in a continuous drier; this was usually an indirect steam-heated disc drier or a direct-fired rotary drier.

A fair number of MIRINZ systems were installed in the 1980s, particularly in New Zealand. They met the requirements of lower energy use and better quality end products, but had some drawbacks:

- **High waste loadings** — early MIRINZ systems put the stickwater down the drain as waste. This liquid had very high contaminate loadings (for example, a 5 tonne/hr plant had the equivalent wastewater load of a town of 5,000 people).
- **Loss of product** — pouring the stickwater down the drain meant wasted product, as stickwater has a proportion of dissolved solids. Depending on the age and type of raw material, the solids in this liquid could be 10–20% of the meal yield.
- **High maintenance** — both the grinders and decanters used in this process required a high level of maintenance.

Second advance: the press dewatering system

The next development in low-temperature rendering took place in the mid-1980s, when disc precookers and the twin-screw press replaced rendering vessels and decanters. The press came from European fish-meal processing technology, which was modified to suit red meat rendering. Rather than using decanters to separate the solids and liquid, plants started using a twin-screw press to achieve the primary solids–liquid split.

The twin-screw press eliminated the need to use a grinder for size reduction, and so a coarser particle size could be used. This meant the high-maintenance grinders could be removed from the rendering process.

Press dewatering systems have grown in popularity in the last 30 years. The large majority of New Zealand's rendering plants use the press dewatering system, and many such plants have been built in Australia.

Third advance: waste heat evaporators

The press dewatering system, like the MIRINZ system, still produced high-strength wastewater containing dissolved solids. The solution to this problem was found in a waste heat evaporator.

The evaporator utilises the vapour boiled off in the drier to concentrate the solids in the stickwater. These solids can then be added back to the drier and the solids recovered into the meal, which eliminates almost all of the wastewater load.

In summary: modern low-temperature rendering systems

The press dewatering system combined with a waste heat evaporator plant has become the standard for rendering operators looking for the best returns. The technological development over the last 30 years has produced a robust process that meets the requirements of modern processors. Rendertech continue to make refinements to our system design for increasing gains in performance, greater robustness, and equipment that is easier to operate.


SWL 1000kg

INSIGHT

How temperatures affect tallow quality

Tallow quality is affected by the temperature it is exposed to. In a low-temperature process, the tallow is never exposed to temperatures above 100°C.

In a high-temperature system — up to 140°C — natural pigments in the raw material can fix onto the molecular structure of the tallow during the cooking process, giving the tallow a high FAC colour. Scorching can also occur. These factors can colour the tallow a red-brown, which is very difficult, if not impossible, to remove through bleaching.

Non-bleachable tallows are sold at lower prices than bleachable tallows

Due to tallow damage issues, extensive gut cut-and-wash processes must be undertaken before raw materials are put through a high-temperature rendering process. This creates additional work, produces additional wastewater loading, and reduces yields as protein and fats are washed off the raw material and lost along with the wash water. And even with extensive cut-and-wash, a plant might not be able to produce a bleachable tallow, especially with ovine raw material.

Low temperatures are gentler on tallow

By comparison, extensive cut-and-wash is not required for low-temperature rendering. Normally, only opening of the gut is required, with the paunch contents being left to drain.

Tallow from low-temperature rendering may pick up some colour from gut contents, but this is easily removed in the bleaching process as the colour particles are not bound to the tallow.

Removing plastic from tallow for the biofuel industry

The level of polyethylene in raw material — from contaminates such as ear tags, plastic bags and other waste — is a major consideration for tallow that is used as a biofuel feedstock. Polyethylene remaining in the tallow can damage a biofuel plant, and the biofuel industry sets strict limits on the allowable level of polyethylene in the tallow they purchase.

The issue with high-temperature rendering is that it can result in higher polyethylene levels melted into the tallow. In low-temperature rendering, by contrast, the tallow is separated from any plastic before it can become an issue. The polyethylene therefore remains with the solids. There are now processes available to remove the plastic from the protein meal after drying and before milling.

OUTCOMES

Features and benefits of low-temperature rendering

In our experience, moving from high-temperature to a low-temperature rendering system reduces steam usage by up to 43%; we also find it easier to produce a bleachable, higher quality tallow, and the odour footprint is substantially reduced. Below are some examples of the benefits gained with low-temperature rendering technology.

Steam usage comparison.

27% less steam than high-temperature rendering.

RED MEAT EXAMPLE

The following energy comparison is based on:

Water	**55%**
Fat	**25%**
Solids	**20%**
Throughput	**10 tonne/hr**

	Low-temperature rendering	High-temperature rendering
Steam use per tonne	**0.55 tonne steam/tonne raw material**	**0.75 tonne steam/tonne raw material**
Steam usage per hour	**10,000 kg x 0.55 = 5,500 kg/hr**	**10,000 kg x 0.75 = 7,500 kg/hr**

Note: the above figures don't allow for efficiency losses or start-up loads.

Processing 180 tonnes per day with a low-temperature rendering plant will save almost 36 tonnes of steam per day, 2 tonnes per hour — or 27% less steam.

Steam usage comparison.

43% less steam than high-temperature rendering.

POULTRY EXAMPLE

The following energy comparison is based on:

Water	**70%**
Fat	**10%**
Solids	**20%**
Throughput	**10 tonne/hr**

	Low-temperature rendering	High-temperature rendering
Steam use per tonne	**0.55 tonne steam/tonne raw material**	**0.97 tonne steam/tonne raw material**
Steam usage per hour	**10,000 kg x 0.55 = 5,500 kg/hr**	**10,000 kg x 0.97 = 9,700 kg/hr**

Note: the above figures don't allow for efficiency losses or start-up loads.

Processing 180 tonnes per day with a low-temperature rendering plant will save almost 76 tonnes of steam per day, 4.2 tonnes per hour — or 43% less steam.

The reduced steam usage is obviously a big cost saving. And it also means that a smaller steam-generating plant may be installed with associated reduced operating costs, such as less boiler chemicals.

Heat rejection comparison

50% less heat to reject than in high-temperature rendering.

As part of any rendering process, a large amount of heat is generated as a by-product of the cooking and drying processes. If this heat is not utilised to produce plant hot water, then rejecting the heat adds further expense due to larger condensers, cooling towers, electrical power consumption and cooling water requirements, etc.

Low-temperature rendering plants utilise this excess heat by using waste heat evaporators — the heat in the vapour from the drier is used to evaporate water from the stickwater. This reduces the size of the heat rejection equipment and reduces operating costs.

A low-temperature rendering plant produces around 50% less heat than a high-temperature plant.

Wastewater comparison

Low-temperature rendering is more environmentally friendly and has lower wastewater loadings than a high-temperature rendering plant.

Firstly, low-temperature rendering requires less raw material preparation. Generally, the paunches only need to be opened and the contents drained. The paunch contents can be sent for composting.

In a high-temperature plant, however, more extensive cut-and-washing is required. This water adds to the wastewater load, and washes away both protein and fat instead of recovering these as saleable products in the rendering process.

The low-temperature process also recovers all of the stickwater produced by concentrating it in the waste heat evaporator before it is added back into the solids for final drying. In this way, all of the dissolved proteins and fat can be recovered and processed instead of going down the drain.

And, finally, the separator sludge is recovered in the low-temperature rendering process, preventing this high-strength stream from going into the wastewater.

Odour comparison

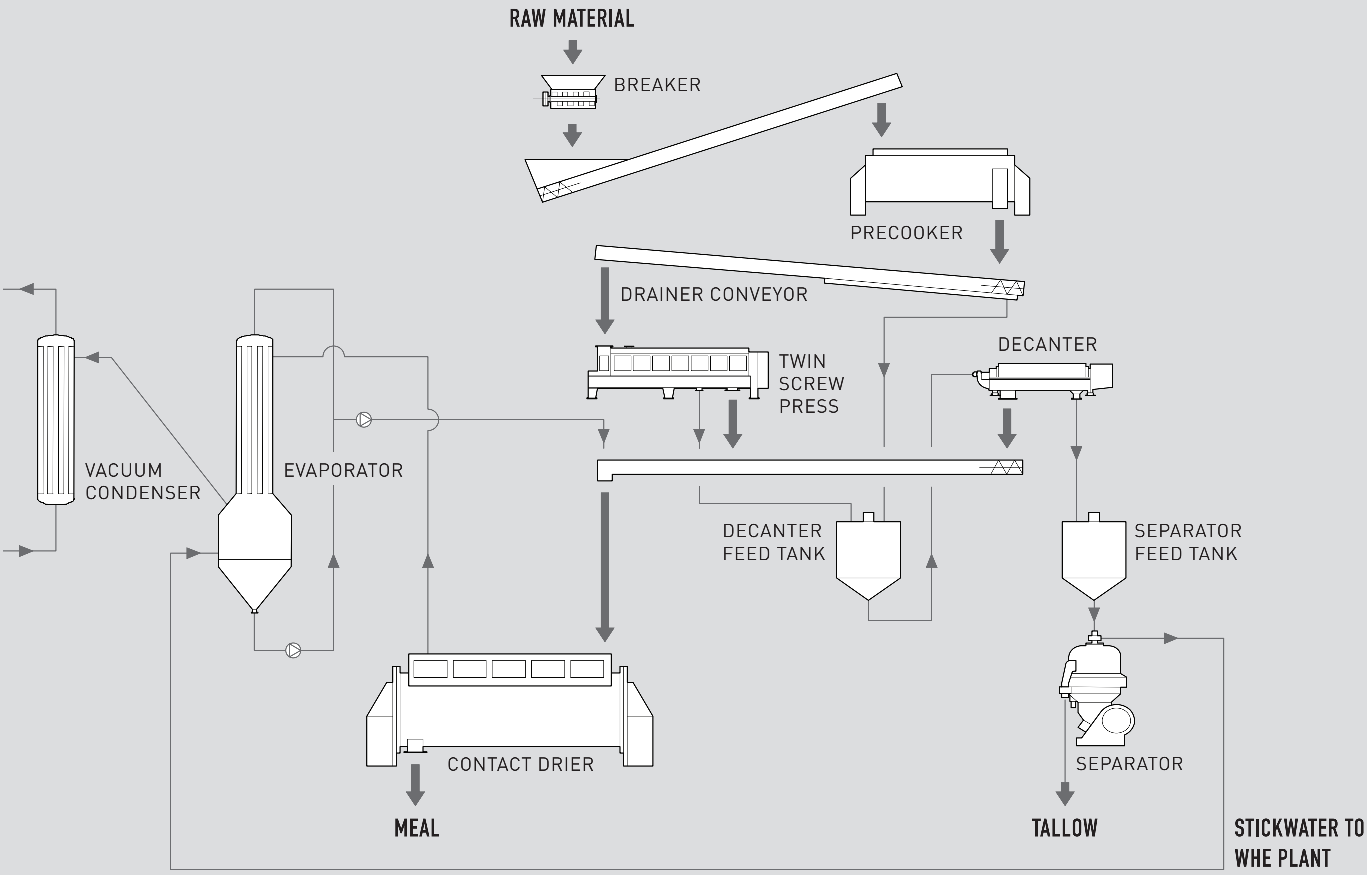
In high-temperature rendering, some fat molecules can become volatile at high temperatures and, if vented, are a large source of odour. The scorching of the tallow at high temperatures also produces odour. These odour streams require a higher level of cooling and treatment, and can be difficult to deodorise with biofilters.

The odours produced by a low-temperature rendering process, by comparison, are easier to capture and treat. Many low-temperature rendering plants have been built in city locations close to sensitive receptors.

HOW THEY WORK

Modern low-temperature systems

Press Dewatering System



The Rendertech Press Dewatering System (PDS) is a low-temperature wet rendering process suitable for plant raw material capacities of 5 tonne/hr and above.

SYSTEM DESCRIPTION

Raw material preparation
Raw material is broken in the Fine Breaker to give a particle size of 20–25mm. The crushed material is then conveyed to the Precooker.

Precooking
The Precooker is a continuous indirect heat exchanger. It consists of an outer shell and a heated disc rotor. The heat transfer is by rotation of the rotor in the raw material. The raw material is fed continuously to the Precooker where it is heated rapidly to 90–100°C to coagulate the proteins and break down the fat cells. The temperature is controlled by automatic regulation of the steam supply pressure.

Pressing
After precooking, the raw material is continuously discharged from the Precooker

Modern low-temperature systems

Press Dewatering System continued

and conveyed by the Drainer Screw to the Twin-Screw Press. Free liquids percolate out in the Drainer Screw; then, in the press, most of the remaining fat and water is removed, leaving a cake with a moisture content of 45–55%.

The press and drainer liquid, consisting of fat, water and a small percentage of the fine solids, is pumped to the Decanter Feed Tank and the press cake is continuously conveyed to the Drier.

Tallow refining

The press liquid is reheated in the Decanter Feed Tank before being pumped to the Decanter for removal of fine solids. The fines are discharged into the Drier Feed Conveyor and the liquids flow to the Separator Feed Tank. Acid is automatically added according to the system settings and the liquid reheated before final 'polishing' in a disc Separator to remove the remaining moisture and fine solids. The stickwater (water phase) is pumped to the Waste Heat Evaporator. The separator sludge is recycled to the Precooker and the polished tallow is pumped to storage.

Stickwater concentration

The stickwater, which contains dissolved protein and fat, is concentrated in the Waste Heat Evaporator using vapour from the Contact Drier (CD). The concentrate is pumped to the CD.

Drying

The defatted solids from the press, decanter fines and stickwater concentrate are dried in the Contact Drier. The meal leaving the drier is ready for milling and screening.

Ancillary equipment

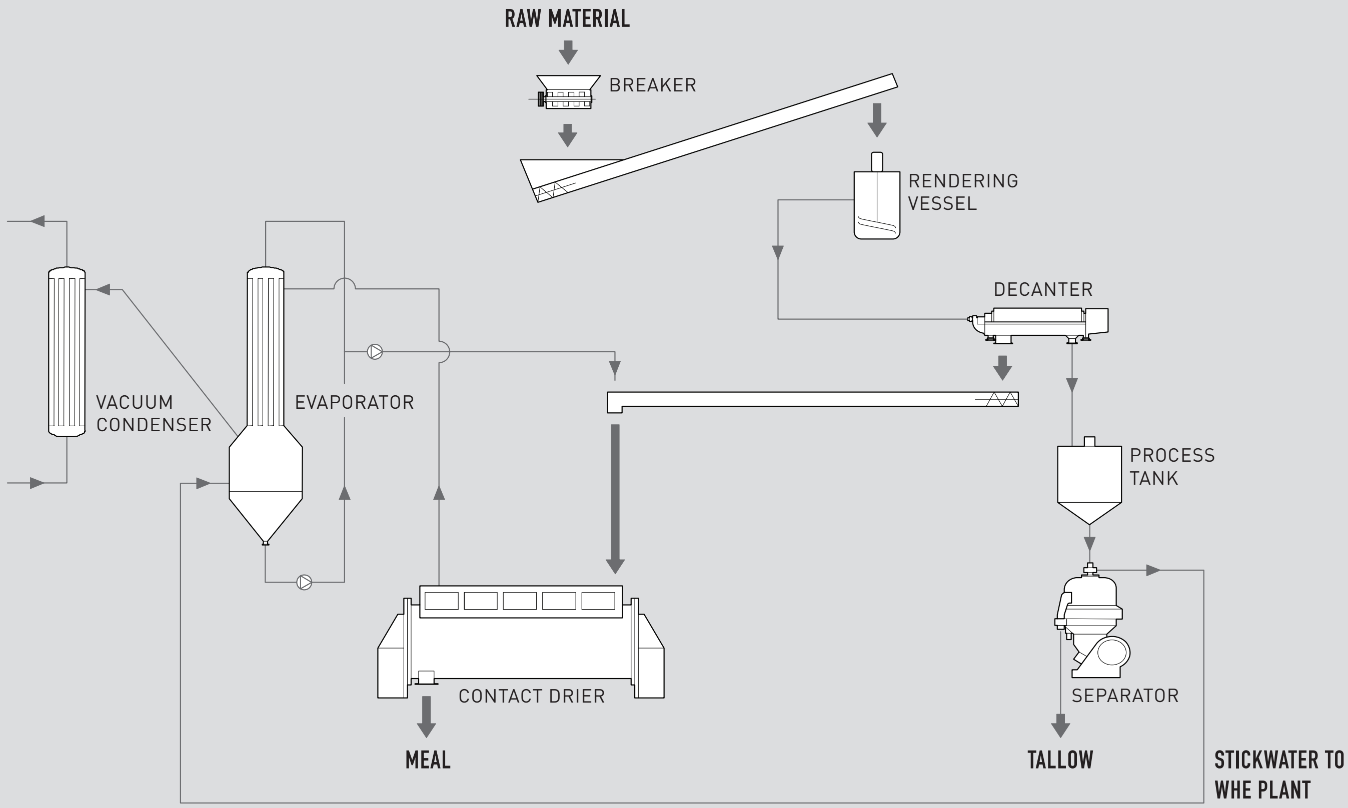
Rendertech can provide ancillary equipment to suit the specific requirements of your site, including raw material preparation and storage, conveying, meal milling and storage, tallow storage, steam generation, heat recovery, odour control, and wastewater treatment.

OPTIONS

- Standard designs from 5 to 25 tonne/hr
- Flexible layouts to suit available space
- Complete turnkey installation

Modern low-temperature systems

Centrifuge Dewatering System



The Rendertech Centrifuge Dewatering System (CDS) is a low-temperature wet rendering process suitable for plant raw material capacities up to 10 tonne/hr.

SYSTEM DESCRIPTION

Raw material preparation
Pre-broken raw material is passed through a metal detector and fed into the Grinder. The minced material is then pumped to the Rendering Vessel.

Rendering Vessel
The Rendering Vessel is a continuous indirect heat exchanger with an internal steam-heated coil. Heat transfer is through direct contact between the raw material and heating surface. Raw material feeds continuously into the Rendering Vessel, where rapid heating to 90–100°C coagulates the proteins and breaks down the fat cells. Temperature is controlled automatically by regulation of the steam supply pressure.

Solid–liquid separation
From the Rendering Vessel, material is pumped

Modern low-temperature systems

Centrifuge Dewatering System continued

to a Decanter to have solids separated from the liquid phase. The liquid (fat and water) flows to the Separator Feed Tank. Acid is automatically added to the liquid, which is then reheated before final polishing in a disc Separator.
The stickwater then flows to the Waste Heat Evaporator for further product recovery.

Drying
The solids separated in the Decanter — which contain 50–60% moisture — are conveyed to the Contact Drier for drying. The meal leaving the Drier is ready for milling and screening.

Ancillary equipment
Rendertech can provide ancillary equipment to suit the specific requirements of your site, including raw material preparation and storage, conveying, meal milling and storage, tallow storage, steam generation, heat recovery, odour control, and wastewater treatment.

OPTIONS

- Standard designs from 3 to 10 tonne/hr
- Flexible layouts to suit available space
- Complete turnkey installation

Low-temperature rendering plants are used extensively in Australia and New Zealand by operators who want to keep their costs low, produce the best end products, and minimise their environmental impact.

Rendertech can help you through all the stages of building a rendering plant, including economic analysis, regulatory consent, process design, equipment supply, installation and commissioning.

We provide through-life support for our plants and equipment including plant audits, process improvements and major equipment maintenance.

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