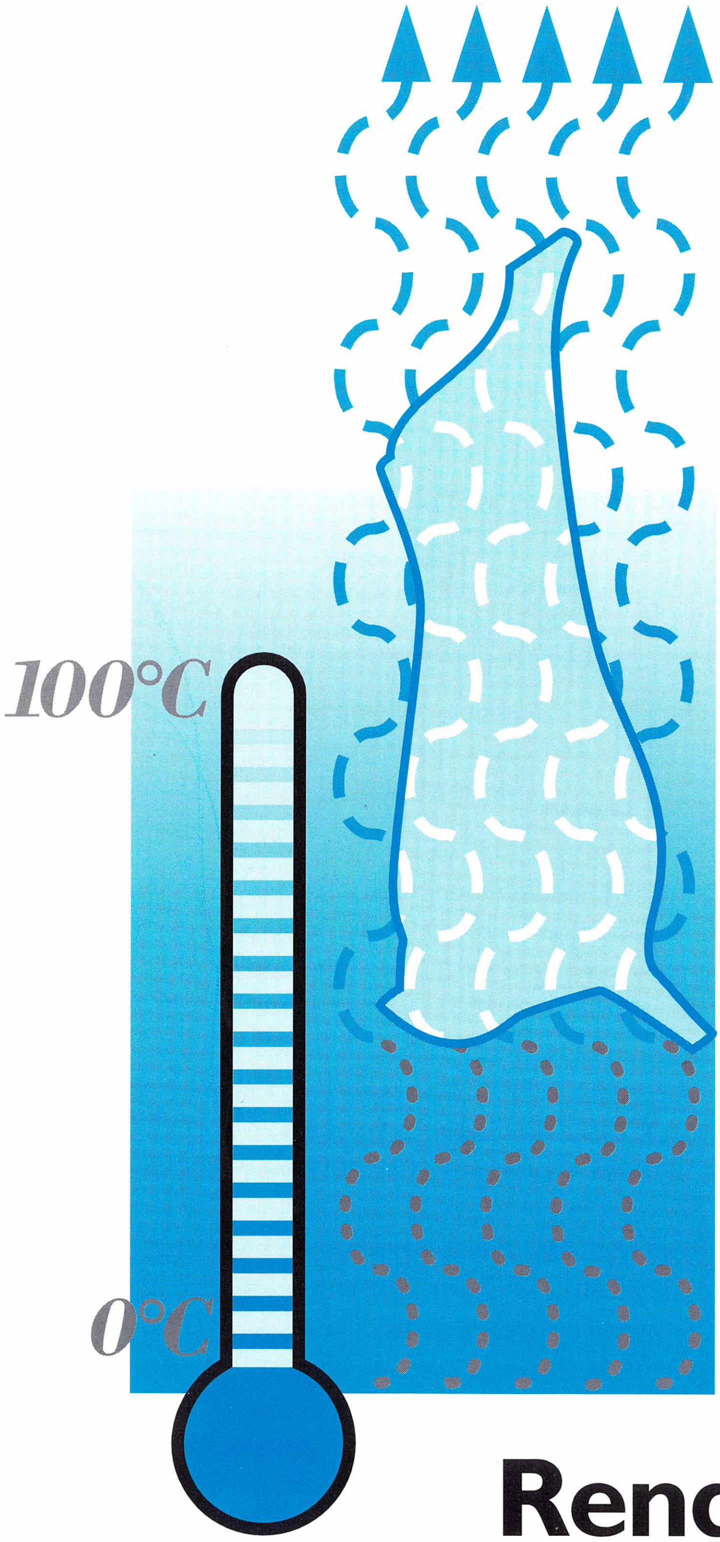


Rendering

1997

Meat Research Corporation

AMT
AUSTRALIAN MEAT TECHNOLOGY

Rendering refers to the processes that are used to separate water, fat and protein components including blood, bone and meat materials into commercial by-products (meat meal, tallow and dried blood). The basic purpose of rendering is to produce stable products of commercial value which are free from disease-bearing organisms. The raw material used is often unsuitable or unfit for human consumption. Two basic processes are involved in rendering: separation of fat and drying of the blood; bone and meat materials.

Rendering Systems

Rendering processes can be broadly classified into wet and dry systems. Table 1 shows some typical wet and dry rendering processes.

TABLE 1 Common rendering processes with typical operating temperature ranges (summarised from Swan, 1992)

Rendering Type	Mode of Operation	Temperature Range (°C)
Dry	Batch	105-130
	Continuous	105-140
Wet	Batch/Semi-continuous	90-140
	Continuous low temperature	60-95

Wet Rendering

Wet rendering systems involve direct steam injection into the vessel. Batch and continuous versions are possible. In older systems, pre-ground raw material is cooked in a closed tank. Fat floats to the top and is drawn off and removed, and polished in disk centrifuges to produce tallow. The water phase is drained off, and the solid material is removed and dried to produce dried meat meal. Newer systems are semicontinuous, and involve cooking the raw material in a conventional dry rendering cooker, sometimes under pressure for a short time. The pressurisation helps to ensure sterilisation of the product. The cooked material is then passed through decanters to separate the solid and liquid phases. The meal is dried in continuous dryers and the fat is separated from the liquid phase in disk centrifuges. Less energy is used than in conventional wet or dry rendering systems, and high quality fat and low-fat meal are produced.

FIGURE 1(a) Wet rendering system (Swan, 1992)

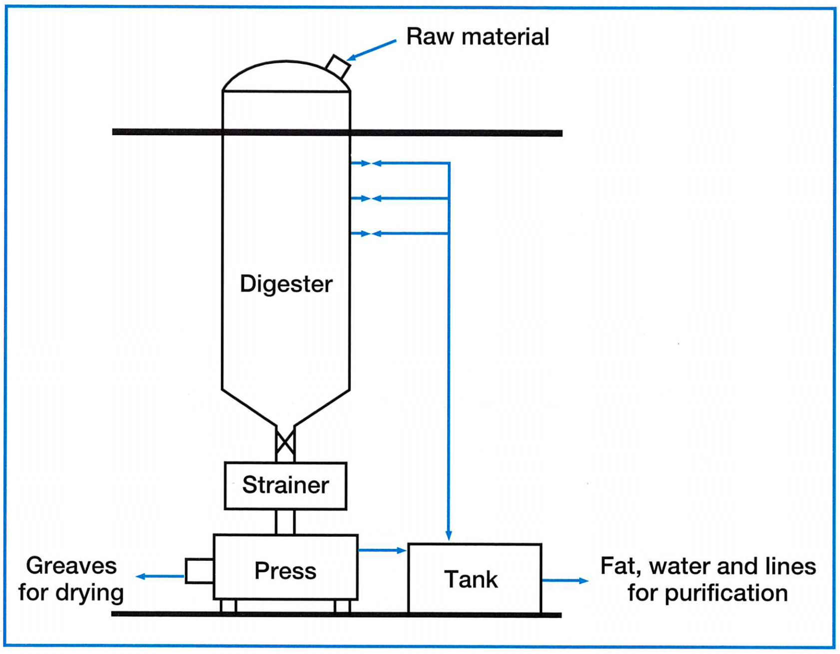


Figure 1(a) shows a typical wet rendering cooker system, and Figure 1(b) shows a semicontinuous wet rendering system.

Dry Rendering

Both batch and continuous processes also exist for dry rendering. The raw material is heated in a steam-jacketed vessel until most of the water has evaporated. The evaporated water is condensed to recover heat, and the remaining solid material is pressed (a continuous operation) or centrifuged (a batch operation) to separate the fat from the protein and other solid materials. The polished fat from dry rendering systems is generally of poorer quality and the meat and bone meal have a higher fat content than those from wet rendering or low-temperature rendering systems. Figure 2 shows a typical dry rendering system.

Figure 1(b) Semicontinuous wet rendering system (Swan, 1992)

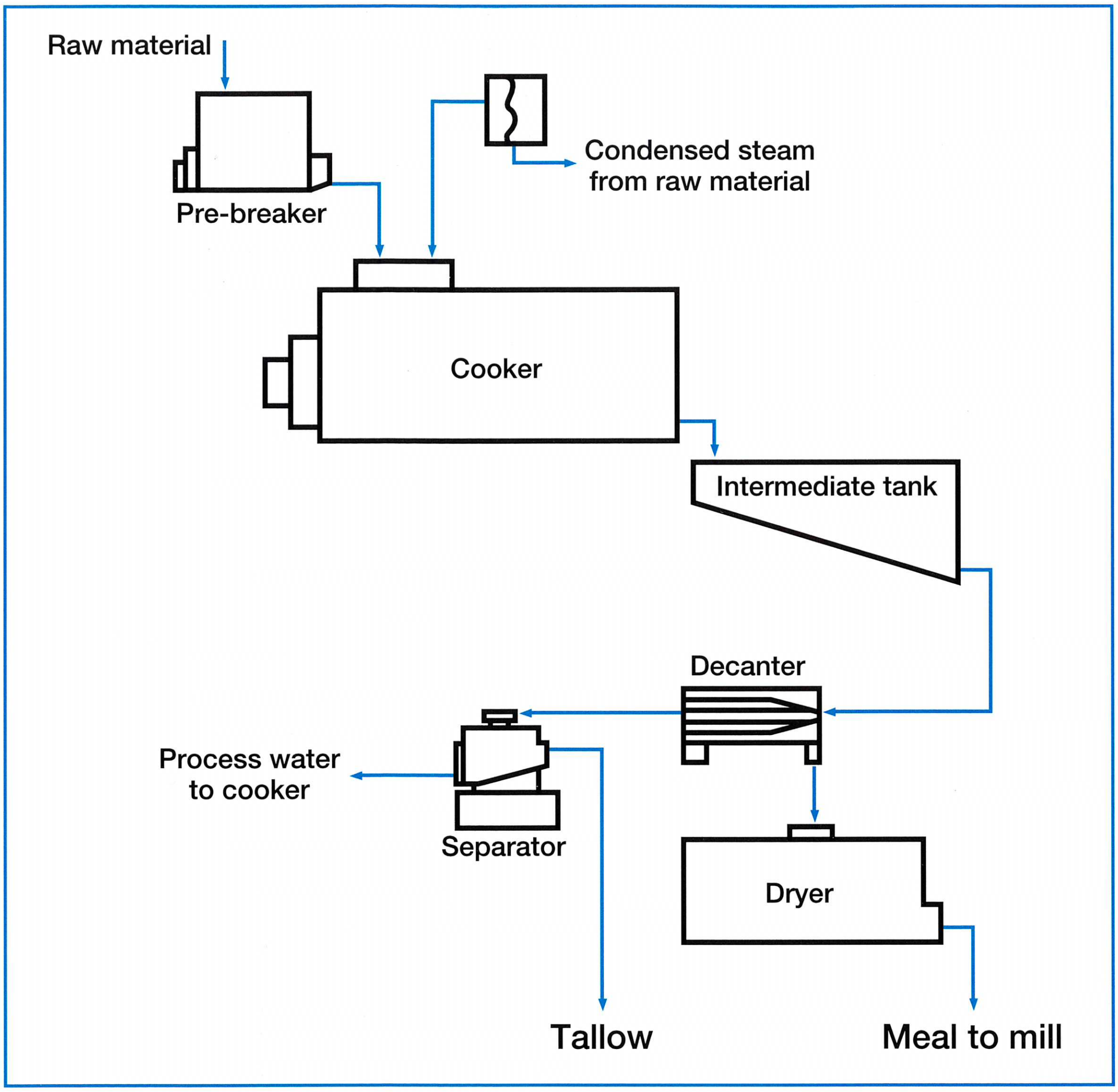
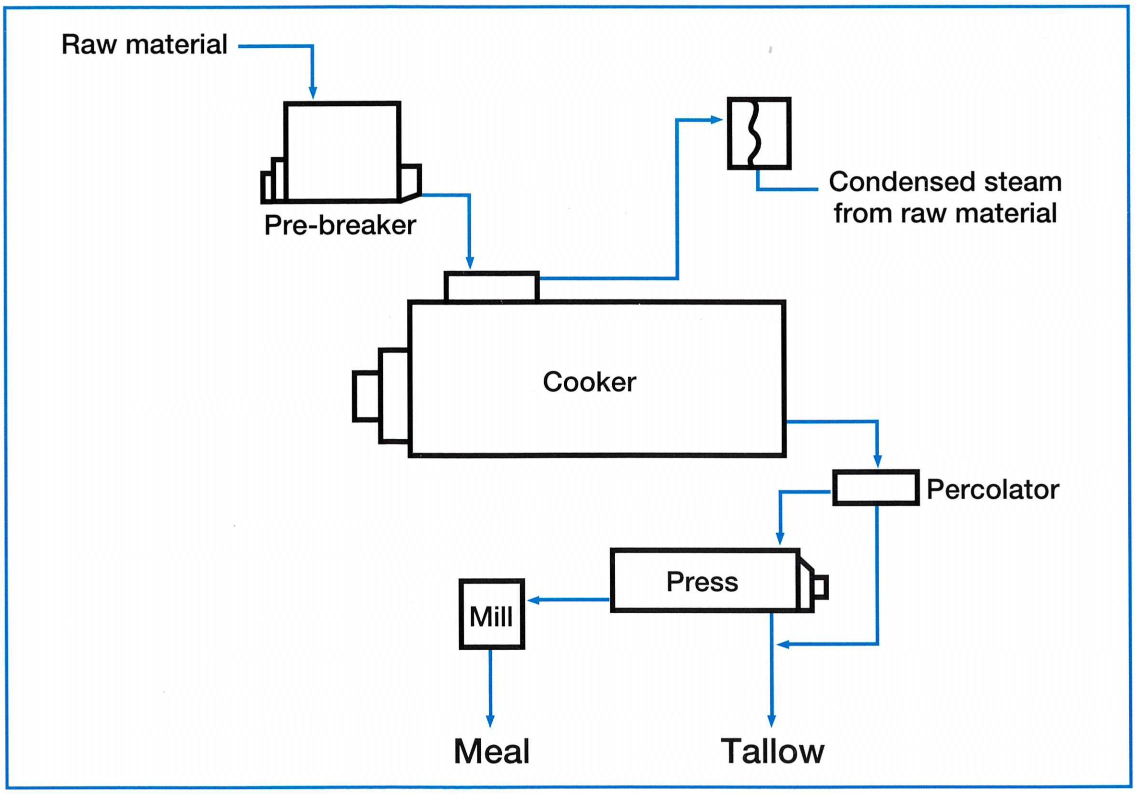


Figure 2 Dry rendering system (Swan, 1992)



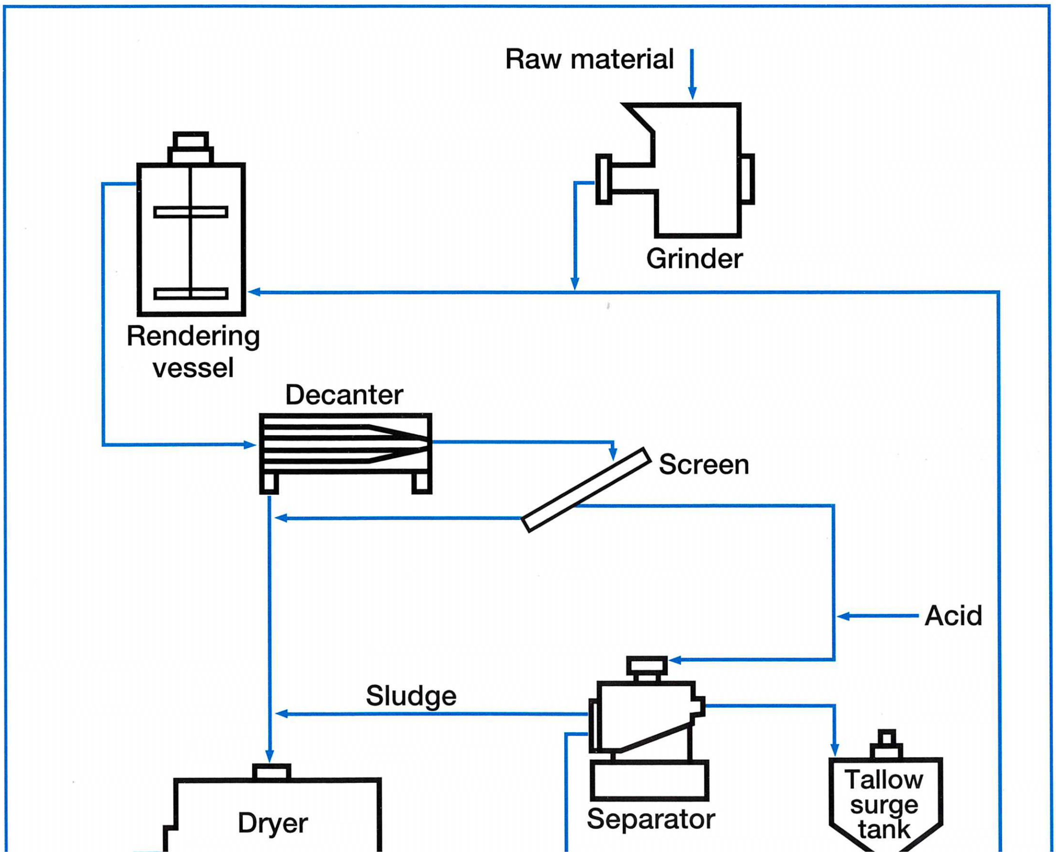
Continuous dry rendering has most of the advantages of batch systems, although pressurisation is not possible.

Low-temperature Rendering

Low-temperature rendering processes are a newer technology, developed in the late 1970s to overcome some of the problems with dry rendering such as lower tallow quality. Heat treatment is minimised and material separation is carried out at low temperatures (70°C to 100°C). As with other wet rendering systems, product drying is required, which consumes energy, although energy requirements for LTR systems are usually about half of those of dry rendering systems in terms of steam consumption (Fernando, 1982). This proportion is lowered if the water is removed prior to drying. Furthermore, as a consequence of the low-heat treatment, a high fat quality is produced, and the meat and bone meals have a low fat content and high nutritional value. However, LTR systems have high capital costs and usually require highly trained technical operators. Figure 3 shows the layout of the Meat Industry Research Institute of New Zealand (MIRINZ) low-temperature rendering system. Compared with dry rendering plants processing similar materials, the MIRINZ low-temperature rendering plants use 50-70% of the gross energy (electricity and steam) and 80-105% of the net energy (after allowing for hot water recovery) (MIRINZ Technical Report No. 839).

Disadvantages of wet rendering processes are the high volume and concentration level of wastewater generated. Larger wastewater treatment systems are required to cope with the extra wastewater volume and nutrient loads.

FIGURE 3 **MIRINZ low-temperature rendering system (Swan, 1992)**



The most common method used in fat separation is heat, which ruptures the fat cells and liquifies the fat for further processing and purification. Enzymic and solvent extraction can also be used; however, further processing is required to remove the chemicals.

Blood Processing

Blood is collected from the slaughter floor and is processed to produce dried blood meal.

Three methods can be used in blood processing:

1. Apply indirect heat to the whole blood to remove most of the water in an analogous way to batch dry rendering. This method is very energy-inefficient and is not widely used in modern plants.

2. Coagulate the blood by direct steam injection at an optimal coagulating temperature of 89°C. Separation of the solid coagulated blood from the water and plasma is then performed with a decanter. The final step in blood processing involves drying of the product. Several methods are available for drying blood. These include batch dryers, rotary gas-fired dryers and ring dryers. This method is more energy efficient than the first method because about half of the water is removed mechanically before drying.

3. Pass whole blood through an ultrafilter to concentrate it, and then dry the concentrate in a spouted bed dryer (Pham, 1983). This method is energy-efficient and produces better quality blood, although higher operating costs are apparent with expensive filter media replacement and high operating pressures requiring special pumping equipment.

The dried blood meal product is a cheap source of animal feed supplement, with a high protein content and a moisture content of 8-10%.

Energy Use

The energy used by rendering systems depends on the type and mode of the rendering plant. As previously discussed, conventional batch wet rendering systems require the most energy input, followed by dry rendering, semicontinuous wet rendering and lastly, low-temperature rendering processes which require the least amount of energy input.

The main options available for reducing the energy requirements in rendering plants include:

- Upgrade to a lower energy plant. This is both costly and time consuming, but a definite option for plants intending to upgrade; and

- Recover energy from the cookers for heating water or pre-heating raw material before it enters the cookers. This method can be applied for all rendering systems, and is especially useful in wet rendering systems where considerable amounts of steam are generated both from the injected steam and water evaporated from the raw material.

Other issues to consider include:

- Continuous systems have smoother energy demands which reduce energy consumption and costs. Boilers can be run at close to peak efficiency and not part-loaded.

- Batch systems have a time-variable energy load demand. This results in difficulty with boiler loads (also variable). Cookers and dryers need to be managed to give a profile as smooth as possible.

Product Sterilisation to Comply with Input Requirements

Although Australian meat and bone meal exports are not subject to any conditions or restrictions under the Export Control Act, some importing countries have specific requirements. The Australian Quarantine

Inspection Service (AQIS) can certify that importing country requirements have been met (MRC/AMT, 1997).

For example, the European Union countries require all meat meal made from mammalian animals be exposed to a heat treatment of 133°C at 3-bar pressure for 20 minutes and have a particle size of less than 50mm. Non-mammalian materials must be processed using heat treatments that eliminate *Clostridium perfringens.* Most batch rendering systems treat the material at temperatures above 130°C for at least 20 minutes to comply with these requirements.

Summary of Key Points to Improve Energy Efficiency in Rendering Plants

1. Reduce particle size to improve heat transfer.
2. Minimise the amount of water in raw materials for dry rendering.
3. Remove and minimise excess water prior to drying (for wet rendering and for low-temperature rendering systems).
4. Continuous processes are better than batch to provide a smoother energy demand profile.
5. Rendering and hot water generation are the predominant heat energy users of meat plants. Overall plant heat energy usage can be reduced substantially by maximising heat recovery and reducing point-of-use consumption.

References

1. Caddigan, M.S.C. and Swan, J.E. 1985, 'Energy Use in MIRINZ Low-temperature Rendering Plants', *Meat Industry Research Institute of New Zealand Technical Report No. 839.*
2. Fernando, T. 1982, 'The MIRINZ Low-temperature Rendering System' in *Proceedings of the 22nd Meat Industry Research Conference, Meat Industry Research Institute of New Zealand, Hamilton, New Zealand,* 1982, Publ. No. 816, pp. 79-84.
3. Pham, Q.T. 1983, 'Behaviour of a Conical-spouted Bed Dryer for Animal Blood', *Canadian Journal of Chemical Engineering, 61,* pp. 426-434.
4. Swan, J.E. 1992, 'Animal By-product Processing' in *Encyclopedia of Food Science and Technology,* (ed. Y.H. Hui), pp. 42-49, John Wiley & Sons Inc., New York.

Additional Information

More detailed information on this subject is provided in the following:

'Analysis of Rendering and Hot Water Heat Energy Use in Meat Plants', in *43rd Congress Proceedings, Auckland, New Zealand,* 1997, pp. 2-7, N.D. Amos, CSIRO.

'Importing Country Requirements for Meat and Bone Meal', 1997, Information Brochure, Meat Research Corporation (MRC)/Australian Meat Technology (AMT).

Additional information

Additional help and advice are available from Food Science Australia, Meat Industry Services Section:

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