final report

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The costs of rendering

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Executive summary

1. This report on the use of KPI's and the costs of rendering meat plant materials involved the development of a model of the rendering processes and associated costs. Without the model as a reference the project would have been significantly more difficult. The development of the model has also provided a resource for future use.

2. To determine suitable base references for the establishment of key performance indicators the use of Raw Materials, finished products and Hot Dressed Carcass Weight s were considered. The lack of recording of raw materials sent to rendering made the use of this measure inconsistent and therefore measures based on material output and carcass weight were developed.

3. While a number of costs associated with rendering were surveyed the major costs elements of labour, Interest and depreciation, repairs and, maintenance and energy were identified as being the important cost elements incurred by rendering operators.

4. Other costs such as environmental management and transport are not consistently incurred by the majority of processors and are therefore not included in the KPI's.

5. Rendering operations are capital investment based industries and incur relatively stable fixed financing and overhead costs. Labour employed is relatively low and energy costs are the largest variable cost item. Essentially the costs structure of an operation is largely dependent on the capacity utilisation of the plant.

6. Meat processors with on site rendering facilities do not generally measure or price in the cost of raw material sent to rendering. Service renderers do account for raw material received for processing. Consequently material rendered on site has no recorded value whereas service renderers incur costs for raw material and transport. For the purposes of costing operations of on site rendering raw material was priced at $100 per tonne.

7. At $100 per tonne for raw material not all on site rendering operations would be profitable however with nil values for raw material all rendering operations provide positive returns for companies. Service renderers incur costs in securing raw material and in transport effectively setting a base raw material price equivalent for meat processors.

8. Even at breakeven it is reasonable for meat processors to render products since the alternatives for disposing of the product, which can account for approximately 25% of the live weight of the animal, would need to be disposed of by other means incurring both cost and environmental problems for the meat processor.

9. Generally returns for rendering for meat processors are returned to the business as part of the revenue accounted for in the abattoir operations.

10. Energy costs are the largest single cost incurred in rendering meat products. While some energy recovery is available to on site operations, mainly in providing hot water to the meat processing plant, the options for service rendering operations are more limited.

11. Energy costs show the largest variation between processors with the variation largely related to the selection or choice of boiler fuels.

12. While processing costs are high in terms of percentage of cost for finished rendered products they are low when measured as cost of processing livestock through the abattoir. Typically rendering costs are within a range of $130 to $265 per tonne which equates to a range of $0.04 to $0.079 per kg HDW. The majority of the variation in processing cost is accounted for in the variation in the costs of energy with most other cost elements being similar between plants.

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1 Background

Meat and Livestock Australia have commissioned this work to look at the costs of rendering with a view to identifying KPI's (key performance indicators) and quantifying the costs of rendering. Once costs have been identified research project may then be applied to reduce these costs

The rendering process used in the meat processing industry (as well as poultry and fish) is essential to the continued operation of the industry. While rendering operations are generally financially viable to process (or something with a similar function) would need to be used by the industry to dispose of its waste material. (This could also be viewed as a valuable raw material for rendered products) This waste stream can amount of 25% of the live weight of the animals processed in the industry.

The rendering process may loosely be defined as a process that cooks animal products to remove the water content and allow the separation of liquid (fats) and solid constituents. While there are a variety of means and equipment to achieve this result the rendering process may, in general, be broken into three broad categories of process.

1. High temperature batch cooking.
2. High temperature continuous cooking
3. Low temperature continuous cooking.

Methods 1 and 2 rely on evaporation during the cooking process to drive water from the raw material mix, whereas the removal of water content in low temperature rendering (method 3) relies on mechanical separation through the use of centrifuges and then the drying of the solids mix to achieve the specified moisture content for the meat meal.

Work was carried out by CSIRO in 1992 (*By-Products From Sheep And Cattle, W F Spooncer, Meat Research Report 2/92)* to identify the weight of offal and other materials derived from animal processing and the meat meal and tallow yields from this material in the rendering process. The outcomes of this research along with the associated (CSIRO) model are still in widespread use today along with derived data in the Meat Research Corporation publication on Rendering (*1997*). However while the information from this work gives a reliable guide to rendering yields it does not relate to the rendering mass balance or provide financial measures for the rendering industry.

Consequently a computer model has been designed to incorporate a material mass balance of the rendering operations as well as incorporating financial inputs to allow financial performance measures to be determined.

The model was developed and used to standardise both input data for rendering as well as to provide a simple, standard means to determine key performance indicators.

To allow maximum utility for users of the model most of the inputs and rendering variables are able to be modified by the user to tune the model to suit different raw material and plant operating conditions.

While this model combines a large number of variables, a form based user interface has been used to remove the need to navigate the spreadsheets to enter data or to review results. (The operation and use of the model is detailed in a separate operating manual that relates specifically to the operation of the model).

The construction of the model and the discussions with processors has however highlighted the variation in methods of calculating the raw material input and the associated cost structure of the different rendering operations.

2 Structure of Rendering Operations

In many respects the operations management of an abattoir are focused on the meat processing aspects of the business and the rendering operation is the process that handles any residual product that cannot be sold in its natural form (also the form which maximises revenue) or for higher than rendered values. Consequently mixed abattoir material is generally not recorded as an item going to rendering (unless it is going to a service renderer) as raw material but rather is the offset of material not saved as pet-food or offal. Similarly fat and bone from the boning room is the product that cannot be sold as primal meat, trim or bones from that operation and is therefore the material not included in boning room yield. Consequently raw material going to rendering varies inversely to the yield of product saved from both the kill floor and the boning room.

To provide a standardised basis for the input and measurement of rendering costs a computer model using Microsoft Excel has been developed that provides for:

- The input of kill data and raw material inputs to rendering.
- The addition of material brought onto the plant for rendering
- The variation of raw material yields from the meat processing operations
- The variation of rendering yields from raw materials and
- The operating cost elements of the rendering operation.

The output from the model is a single sheet of key performance indicators for the rendering operation that allows comparison between rendering operations and if used regularly by a plant period to period comparisons of performance. This model has been trialled with a number of plants and has highlighted the variation in rendering costs and how data is collected.

3 Costs of Rendering

While the raw material going to the rendering plant obviously has a value as well as attracting transport costs from service renderers, none of the abattoirs visited, with on site rendering, record or place any value on the cost of their raw materials and only one abattoir recorded the weight of raw materials going to the rendering plant. The remainder of the plants work on the basis of yields of MAM and bone derived over time (and generally on the basis of the information contained in the Meat Research Report 2/92 on rendering yields). Once established, yields are generally not reviewed unless there is a significant change in kill profile. In general plant kill profiles rarely change significantly in the short term. Consequently raw material input to rendering is inferred from a calculation on the basis of total daily kill weight without reference to actual material produced. Measures are therefore more accurately calculated on the basis of meals and tallow produced, as the shippings of these finished products are all accurately recorded by the processors.

With this background cost structure processor discussions would often revolve around the option of looking at rendering as a business within the meat processing plant. In general there was not any significant support for treating rendering in this manner with any revenues being returned to the abattoir operations, (either explicitly or implicitly) essentially allowing the company to factor in this revenue stream when considering available margins for livestock pricing.

Consequently, for the purposes of looking at comparison costs, all raw material cost inputs have been based on a value of $100 per tonne (average) as this was agreed by plant operators as the likely and/or an acceptable value of the material.

Meat processing plants tend to see rendering as part of or an extension to abattoir operations. When costs are treated in the same manner there is also some difficulty in easily separating out running costs from more general records, to establish a breakdown of rendering costs. Breaking down the rendering costs into rational areas the following costs were sought to enter into the model.

Labour Costs – the cost and use of labour in rendering operations varies depending on a number of factors.

For meat processors labour is not always dedicated to task or department and consequently staff numbers tend to vary with the work load of the operation as well as the type and age of equipment employed in the operation.

It is unusual for a rendering plant to operate on the basis of a 38/40 hour week and therefore shift working is used on plants to cover the working hours, however this is not generally in finite shift times but varies depending on rendering loads and work needs.

Energy costs –energy usage is largely related to the amount of water that needs to be driven from the raw material to meet the specifications of moisture content in the meat meal. For high temperature systems this water is largely driven off in the cooking process whereas for low temperature systems the water is removed by mechanical separation in the first instance with the remainder being driven off in the drying process. In general terms the amount of energy is both predictable and related to the type of rendering process.

The cost of energy is more related to the fuel medium chosen (or available) as fuel. In general terms the lowest cost boiler fuel is sawdust albeit with a relatively low calorific value, followed by coal with the highest cost being for bottled gas. In many instances there are limited choices for boiler fuel and plants have tended to make pragmatic choices related as much to location/cost factors as much as any other decision process.

While the fuel costs are relatively simple to identify, as a regular ongoing cost, the costs of boiler maintenance is not always easily separated from other repairs and maintenance costs (and these costs may vary significantly year by year).

Similarly the additional associated costs of coal and sawdust use and handling are not necessarily attributed to the energy cost for rendering operations. On this basis the cost of energy used in rendering can be assessed on a fuel usage basis, however this will not reflect the total cost of providing energy.

Hot water recovery from rendering in meat processing plants is a significant offset against energy costs (which are generally not available to service renderers) and is calculated in the model on the basis of nil waste of generated hot water in the plant. However, in practice this may not always be the case as re-use of hot water is dependent on storage capacity at the plant and the timing of hot water generations and demand / use in processing. The general inability of stand alone rendering operations to use recovered hot water in processing, presents additional environmental costs to cool the discharge either for reuse or disposal.

Repairs and Maintenance – Repairs and maintenance are generally recorded accurately through the normal works system of works orders for both internal maintenance work and through the use of outside contractors. However in practice, at processing plants with on site rendering, this system also has flaws. Certainly the costs of materials is well known and the use of outside contractors easy to identify however the use of employed labour is not always well recorded (either by staff or through variable systems in the plant) and in looking at the costs for repairs and maintenance the labour costs are often not presented with absolute certainty.

The variable definition of what constitutes repairs and capital expenditure may often lead to large variations in R&M costs on a year on year basis

Most plant work on the basis that if an item is replaced in its entirety or is purchased new (to extend or improve the plant) then this is treated as a capital expense item, whereas any form or repair or replacement that is less than this is treated as repairs and maintenance. This tends to apply irrespective of the cost of the repair. This practice has the tendency to skew comparisons and inflate single year figures when major repairs are carried out.

Interest and Depreciation – These costs are related to the cost and age of the plant and tend to be offset by the costs of repairs and maintenance. The tendency for meat processors is to group these charges in the total costs of financing the business and therefore costs entered into the model tend to be estimates provided by the processors rather than asset derived itemisation of plant and finance cost.

Environmental Costs – vary considerably with each particular rendering operation and for meat processors with on-site rendering operations their inclusion is related to the ability of the company to separate the environmental costs of rendering from the whole of the plant environmental costs.

4 Benchmarks for Rendering

4.1 Measures Used

When considering the manner of developing benchmarks for rendering operations three constants were identified against which to measure costs:

- Volume of Raw material processed
- Weight/Volume of meal and tallow shipped and
- Average Hot Dressed Carcase Weight of animals processed.

Raw Material Volumes - For meat processors the actual volume of material sent to rendering is not accurately measured (although it can be calculated) and therefore is not a reliable measure against which to compare costs. For service renderers material is generally measured into the plant and therefore this provides a relative measure, although the make up of the material may vary depending on source and daily changes at the processing plant.

Volume of Meal and Tallow Shipped – This is the one measure that is constant between all renderers and is accurately known in all plants and therefore provides a reliable constant against which to measure costs.

Average Hot Dressed Weight of Carcases (HDCW) – While this measure is not relevant to service renderers it is often used by meat processors as a standard for all cost measures across the meat processing plant and therefore aligns with all other measures of performance.

Consequently the KPI's used in the comparisons use costs against product shipped and costs against animal HDCW (where this is known) and use raw material volumes for only a couple of measures and as a determinant of processing yield.

4.2 Raw Material Costs

In the process of modelling the costs of the plants a nominal sum of $100 per tonne was included as the cost of raw material, at this rate of raw material cost some rendering operations could not be considered to be profitable. However, once raw material costs are reduced to zero all rendering operations provide a positive return to the processor. In many respects on site rendering is the most cost effective method of dealing with the raw material since disposing of the material off site is a more expensive option.

4.3 Labour Costs

Labour costs average in the region of $32.15 per tonne of output with a range +80% / - 46%. Variation tends to be on the basis of rendering process (batch cooking requiring more labour than continuous) and the working hours of the plant relative to output. While costs are significant when based on rendering output on the basis of cost per kilogram of meat processed (HDW) the average cost is 0.95c/kg.

The large range of labour costs in due to the small numbers of staff employed in the rendering process and small changes in staff numbers have a significant impact on labour costs.

4.4 Repairs and Maintenance

These costs are related to the age and condition of the plant and average approximately $48.16 per tonne output. With a range of +30% / -11% the top end of the range reflects the cost of maintaining older equipment but only represents a cost difference of 0.5c/Kg HDW. The average cost for repairs and maintenance is approximately 1.5c/Kg HDW.

4.5 Interest Charges

Interest charges associated with the rendering operations fall into a similar cost range to repairs and maintenance at an average cost of $52.0 per tonne output with a range of +26% / -23%. In terms of processing costs this is equivalent to 1.48c/Kg HDW.

4.6 Energy Costs

Energy costs are the largest variable cost, and by far the most significant cost in the rendering operations. Costs vary from $23/tonne output to $112/tonne output. (0.74c/Kg to 3.52c/Kg). These costs have been calculated taking into account all energy related cost declared included heating fuels and electricity etc, although the most significant cost is the energy used for steam

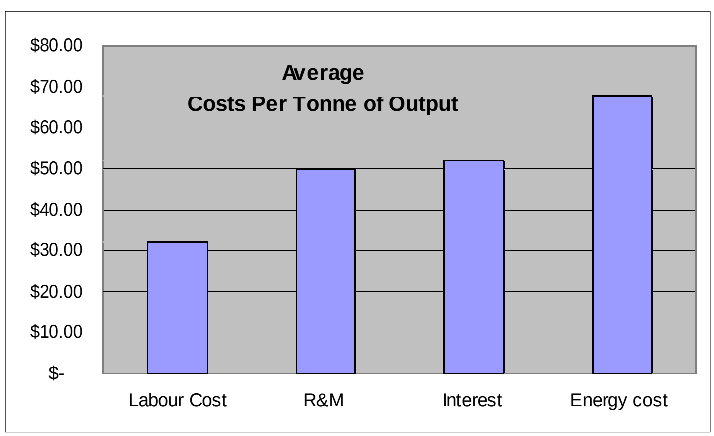

Figure 1 Relative Rendering Costs

generation. The variation between plants is significant with wood chip and sawdust being the lowest cost fuel with coal 50% greater and delivered gas the most expensive. In spite of the fuel costs there is a preference in some respects for the simple and clean operation of gas fired boilers and in many cases the costs of boiler maintenance, ash disposal and other costs are not always factored into operations as a discrete cost.

4.7 Total Cost of Processing

Total cost of rendering raw materials varies from approximately $130 per to $265 per tonne of finished product, (averaging $210 per tonne of finished product) with a significant amount of the variation (up to $100 per tonne) as a result of the difference in energy costs. On the basis of meat processing costs however the total costs of rendering vary between 4c/Kg and 7.9c/kg HDCW for the animals processed. Although the returns from the sale of meals and tallow vary with market conditions on the basis of the costs outlined all meat processors with on site plants retain a reasonable margin to support the meat processing operations.

5 Opportunities for Improving Cost Structures

Looking at the costs of rendering and building a model to standardise the approach of providing key performance indicators we have identified four key areas of processing cost: Labour employed, repairs and maintenance costs on equipment, interest and finance charges, and energy costs. While the ability to input other cost such as transport and environmental costs these are not seen as key indicators as they are not always incurred or separately recorded by processors.

Rendering is recognised as a capital and energy intensive process and as such tends to have a cost structure that is to a large extent difficult to change in the short to medium term. Typically for capital intensive industries the alternative is to increase plant utilisation to reduce unit costs of fixed charges for the operations.

After the initial plant installation there is a reluctance to invest in new plant, even when repairs and maintenance cost have become quite high as it is often cheaper to repair than replace. The other reason for investment is to increase processing capacity. The longevity of the plants and the frequent availability of second hand equipment has led to a situation where the uptake of new rendering methods are slow to be adopted unless there is a significant financial benefit in the new development or pressure is applied, to the company, on environmental grounds. Typical of this environmental driven development is the introduction of bio-filters to replace the incineration of rendering odours as buildings have needed to be enclosed and ventilated. Previous methods for the incineration of odours then became uneconomic at the significantly increased volumes of air that need to be treated. However while there is a saving in fuel from removing the incineration process the cost of electricity to run the bio-filter fans is not insignificant.

Prior to changes in working agreements in meat plants almost all plants worked on single shifts and consequently once meat processing was finished for the day rendering would continue until raw material was processed. With the raw material degrading the longer it is held plants were eager to process the material quickly to achieve the best meals and tallows from the plant. With the move to extended and / or double shift working in meat processing rendering activity now more closely matches the rate of supply of raw material allowing plants to improve product quality. In many instances plants have also increased the numbers of animals killed, although this has tended to take place over time as chilling and freezing capacities of meat processors have been extended. Nevertheless this has allowed an improvement in rendering plant utilisation. While this allows fixed plant costs of depreciation and interest to be amortised over greater production levels it also increases repairs and maintenance costs as the plant is run for longer and repair work carried out on weekends and between shifts incur extra costs.

5.1 Labour Costs

The staff required to operate a rendering plant is generally low, 2 to 3 people per shift, with many companies doubling this on the basis of needing to work 2 shifts a day. Staffing levels at a plant are also related to the type of process and age of the installed plant with batch cookers generally requiring more labour than continuous rendering systems. In this situation it is difficult to reduce labour in discrete amounts (reducing staff from 3 to 2 requires a 50% increase in productivity).

5.2 Repairs and Maintenance

Repairs and maintenance costs in rendering plants tend to be a focus of attention for most operators not only because of the interruptions to production but also because of the equipment repair costs that tend to large and irregular. The control of repairs and maintenance costs and the maintenance of plant are driven by two main items of plant management. With the longer running hours of rendering plants repairs and maintenance are often carried out after processing and on weekends increasing labour costs and applying pressure to job completion before restarting processing.

- Better planned maintenance scheduling – While many plants incorporate scheduled maintenance of their rendering plants management this is often based on the experience of the engineers and the history of breakdowns. Many processing industries now plan maintenance using predictive life modelling of essential equipment. This process requires monitoring of equipment during scheduled maintenance events (rather than only doing maintenance) and using developed software to predict wear rates and likely failure points to allow attention to be scheduled rather than occurring as an unexpected event. The provision of industry derived information on equipment wear and failure conditions under a range of operating parameters would assist plants to develop such practices,

- In a similar manner to developing information on equipment decay and failure equipment designs and repair methods can often be developed out of necessity rather than considered design. Often rendering plant staff and plant engineers will discuss matters that affect plants within a geographical area however a wider register / database of information would often assist plant engineers as well as manufacturers to develop better designs and materials uses.

5.3 Energy Use

Energy use in rendering plants is the most significant cost and in the majority of cases is the largest cost in the rendering operation. To a large degree the cost of energy is almost all variable with production levels and relates to a number of factors on plant.

- The choice of boiler and related fuel source has a significant effect of the cost of energy, although the decision on fuel and boiler once made will only be changed in the long term.
- Efficiencies are available to the plant from the use of waste heat generated by the rendering process, typically these are:
    - Hot water generation to supply to the meat processing plant. This is almost standard at all meat processing plants although with varying degrees of success depending on hot water holding capacity at the plant and the ability of the plant to use the amount of hot water. The hot water requirements for a meat processing plant are significant and while the use of energy for rendering is an expense to the business without rendering the plant would still need to generate hot water for its own processing needs.
    - Excess heat can also be used to preheat material before the main rendering cooker, increasing the theoretical capacity of the plant at minimal cost. The re-use of material preheating will reduce energy use however care needs to be taken not to overheat the material before it enters the cooker, In many cases plants which take in outside material adopt this process as they generate more hot water than they can use and have spare energy for re-use. However if the increased capacity of the plant is not used to reduce other costs (for example reducing the number of shifts) then there is limited gain (energy only) in the process.
    - For stand alone rendering plants with few options for energy reuse the disposal of hot water and waste heat become environmental issues that need to be managed by the plant.

The use of waste heat is logically primarily addressed by heating plant hot water and this provides the best return, however any residual heat could also be used for other processes on plant such as:

- The use of the waste heat through an evaporator to concentrate and recover fats and proteins from liquid waste streams such as stick water and polisher discharge and the raw material bin drainage.
- The use of a heat pump cycle to provide refrigeration for ancillary systems such as kill floor air conditioning.

- The rendering process is a cooking and dewatering process and consequently the amount of energy required is related to the water content and the cooking requirements of the raw material. While the cooking needs of the raw material are relatively fixed, the amount of water in the raw material is a plant controllable input. For many meat processors the issue is addressed by putting in place controls on the volume of water transported to rendering with the raw material.

  Mechanically removing water from the raw material prior to cooking is a relatively common practice, even if only by the use of wedge-wire screens or other means in the bottom of screw conveyors. However, this presents the plant with the issue of dealing with a contaminated waste stream and the possible loss of product in the waste stream.

In summary the opportunities to reduce energy costs, given that the installed boiler plant is not changed, are to consider processes that maximise the waste heat streams and methods to reduce the water content included with the raw material.