RENDERING OPERATIONS

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Summary

Whether rendered products are used in feed for ruminants, poultry, swine, pets, or aquaculture, or for industrial uses of fatty acids, rendering operations and how they are performed will influence production costs, sales quality, and financial success. This chapter will include systems descriptions, a brief operating overview of each system, and challenges, present and future. Also described are systems for management of the process to fulfill regulatory requirements and ISO- or HACCP-like systems.

Energy consumption, production methods, quality control, process control, and the resulting products are all primarily dependent on the raw material and the condition in which it enters the respective processing system. Although it is still impossible to make a "silk purse from a sow's ear," the selection and operation of a particular system can lead to the highest quality finished product possible from a given raw material. Conversely, any system poorly maintained and operated can ruin even the highest quality and freshest of raw material. Environmental repercussions discussed in another chapter are also highly influenced by operations parameters, the system, and the way it is controlled for its process efficiency.

Through the years, various techniques have also been employed to alter the finished quality of the rendered products. Various bleaching techniques, antioxidants, additives, and sometimes adulterants can facilitate chemical detection methods used to classify finished products higher on the quality and price scale than would be possible otherwise. Hence, the basic need for a complete understanding of each raw material, processing system, operating technique, and quality control method used in order to maximize the economic gain, while complying with all requirements and regulations at the same time.

Rendering Systems

Wet Rendering

Wet rendering is a system which leaves a high amount of moisture in the product, until, or if, it is to be dried. It is most commonly applied today in the rendering of edible fats and oils and in the production of items such as partially defatted chopped beef or condensed beef. The earliest of these was an open kettle fired with wood or coal. Fat rising to the top was skimmed off for use. Open kettle wet rendering was quite common on a small scale. There is more detail on this process in the chapter on edible rendering.

Dry Rendering

Dry rendering is done with or without an initial pressurization stage (sterilization) and it is the most common system used today. In the middle third of the twentieth century, the dry rendering batch cooker came to nearly universal use. In the beginning, before adequate pre-breaking or pre-crushing was used, large pieces of animals or offal could be pressurized in the batch cooker prior to drying. This had the same effect as a home pressure cooker and would cause the bones to become more brittle, softer, and easier to handle. Particle size reduction technology eliminated the need for the pressure step for size reduction. However, this pressurization system was re-deployed in Europe as an extra log reduction factor for their bovine spongiform encephalopathy (BSE) control programs. It is unlikely that it will be used again in North America, as other control schemes have been employed to control BSE. There is more detail on the dry rendering process in the chapter on edible rendering.

Pressure is regularly used for hair and feathers to achieve protein digestibility. This can be in a batch or continuous process. Drying of hair meal today is not prevalent, as most of the hydrolyzed hair is added back to the raw material pit and rendered with the rest of the raw material. This has a negative effect on fat yield, yet it is the most practical and energy efficient way of handling the hair. Feathers need the pressure treatment to break the difficult keratin protein bonds. Digestibility levels of nearly 100 percent can be achieved chemically, but that may destroy the availability of the amino acids. Research in the 1970s and 1980s demonstrated a level of 68 to 75 percent digestibility by a pepsin test actually provided the maximum feed value of feather meal. More information on digestibility of feather meal is presented in the chapter on the use of rendered products in poultry nutrition.

Edible Rendering

Edible fats and oils are designated as high temperature or low temperature, as is the resulting tissue. Tissue with enough meat processed at low temperature is beef or pork with the meat-like definitions. High temperature product that is not to be designated as "cooked" or "ready to eat", will generally wind up as meat and bone meal through another rendering system, or possibly go to pet food. Condensed beef is a newer term, and has certain production characteristics that are specialized. Please refer to the chapter on edible rendering.

Batch Rendering

When a system is operating in a batch manner, it becomes a batch system. Even a continuous cooker can be operated in a batch mode. A batch cooker is designed to be loaded, processed to a percentage dry, and then discharged for fat separation. A batch cooker can function as a cooker, dryer, hydrolyzer, or processor, yet it is still the same piece of equipment. With minor modifications, and with or without internal pressurization, a batch cooker can be used for each purpose. It can have a heated shaft as well as shell, increasing the heating surface and efficiency of heat transfer. When used as a sterilization step, the heated shaft can minimize the time required to attain temperature and pressure parameters.

Continuous Rendering

Generally defined as continuous in-feed and continuous out-feed with many still in use, there have been a number of continuous systems employed in the past. One of the first was the Anco Strata-Flow system. By connecting a series of modified batch cookers in a unique fashion, this became the first real continuous system.

Carver-Greenfield systems came on the scene at about the same time that Dupps, along with Keith Engineering, created the DUKE system. Today known as Equacookers, they are the most commonly employed units in North America. The ease of operation before sophisticated computer controls was a major factor in their success.

Companies such as Atlas and Stord-Bartz brought their fish meal know-how to North America in the late 1970s, and became well-known in the 1980s. By using their unique disc dryer/cookers, waste heat evaporators, mechanical vapor recompression, and improving on the original Carver-Greenfield design, they developed a large market share in the poultry and red meat industries.

Consolidation has occurred in equipment supply as with the rendering industry as a whole. Dupps, and now Haarslev (consolidating Haarslev, Svaertek, Stord Bartz, and Atlas-Stord), along with Anco-Eaglin (the modern ANCO), are the major providers of equipment to the North American market. Several other companies provide specialized equipment, rebuilding and repair services, centrifuges, and other options for the industry. With nearly round-the-clock operations, it is essential to have a plant and system that remains in an operating condition, with low downtime and energy efficiency.

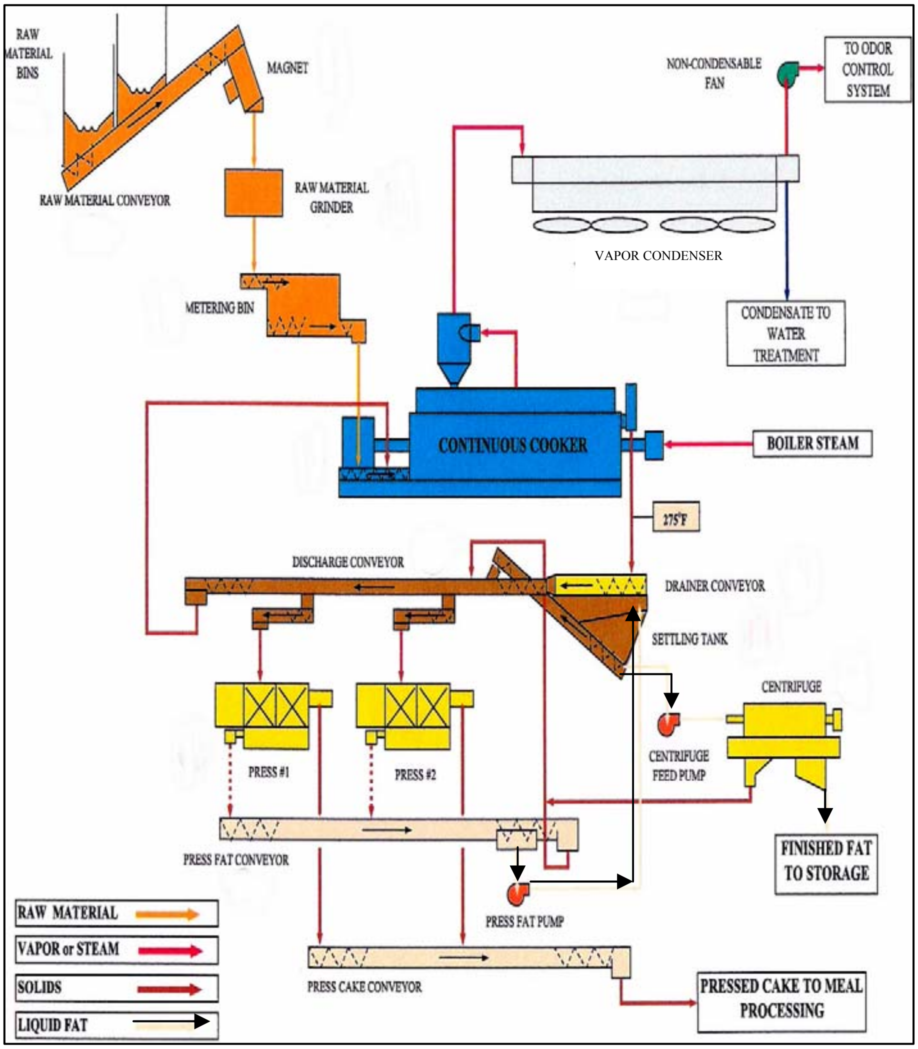
Continuous Rendering Material Flows (Figure 1)

Material to be rendered is received for temporary storage in raw material bins. Raw material is conveyed from the bins by a raw material conveyor and discharged across a magnet to remove ferrous metal contaminants. A raw material grinder then reduces the raw material to a uniform particle size for material handling and improved heat transfer in the cooking step. The ground raw material is fed at a controlled rate from a metering bin into a continuous cooker.

The continuous cooker is an agitated vessel generally heated by boiler steam. It brings the raw material to a temperature between 240º and 290ºF (approximately 115º to 145ºC), evaporating moisture and freeing fat from protein and bone. Dehydrated slurry of fat and solids is discharged from the continuous cooker at a controlled rate.

The discharged slurry is transported to a drainer conveyor. The drainer conveyor separates liquid fat from the solids, which are then conveyed from the drainer conveyor by a discharge conveyor. In the discharge conveyor, solids from the drainer conveyor are combined with the solids discharge from the settling tank

Figure 1. Schematic Diagram of a Continuous Dry Rendering Process.



Adapted from a drawing from The Dupps Company.
Available in color at www.renderers.org/Continuous_rendering_system/index.htm

and from the decanter-type centrifuge. The solids from the discharge conveyor go to the screw presses, which reduce the solids' fat content to about 10 to 12 percent. Solids that bypass the screw presses are recycled back to the cooker. Solids discharged from the screw presses in the form of pressed cake go to the pressed cake conveyor for transport to further processing into meal. The fat removed in the screw presses goes to the press fat conveyor, which separates large particles from the liquid fat and returns them to the discharge conveyor. The fat from the press fat conveyor is pumped to the settling tank. Fat discharged from the drainer conveyor goes into the settling tank. In the settling tank the heavier bone and protein particles settle to the bottom, where they are discharged by screw conveyor into the discharge conveyor. Liquid fat from the settling tank is pumped to the centrifuge, which removes residual solid impurities from the fat. The solids from the centrifuge go to the discharge conveyor. The clarified fat is transported to further processing or to storage as finished fat.

Water vapor exits the continuous cooker through a vapor duct system that generally includes an entrainment trap to separate and return entrained particles to the continuous cooker. The vapor duct system transports the vapor stream to a vapor condenser. Non-condensable gases are removed from the condenser by a non-condensable fan. Odorous gases generated at various points in the process are collected by a ductwork system and are transported along with the non-condensable gases from the condenser to an odor control system for neutralization of odorous components.

Waste Heat Evaporation

Employing an evaporator with a continuous cooker, a waste heat system offers energy savings that will continue to be very important as the global energy balance continues to shift. Some systems installed in the early 1980s are still operating efficiently. Waste heat is also very important to the meat processing industry for generation of hot water. Rising energy costs have a negative effect on plants that do not employ waste heat to generate their hot water.

Low temperature separation, originally used in fish meal production, allowed many of these waste heat systems to achieve very low energy consumption numbers, especially on materials with high water content. Finished product fat quality is also enhanced in any low temperature system. However, care must be taken to prevent rancidity in this fat. Generally heating the dry fat past 250ºF, one time, will accomplish this. It also serves to dry the fat to a lower moisture level.

Waste heat recovery evaporators can be falling film, rising film, or forced flash designs. All have certain advantages and disadvantages, and selection for the characteristics of the liquid is critical. Pre-heating the feed liquid may be required for coagulation of the soluble protein generated in the preheating process, and a glue breaking step may have to be added to allow the easy use of the concentrate into a dryer or cooker. Fish and porcine materials typically have more issues with glue due to the temperatures at which it is released from the material.

Continuous Slurry Systems

These were the various systems such as Carver-Greenfield, and have undergone subsequent changes and improvements by a number of manufacturers. Both designs by Dupps and Atlas-Stord, as well as others, created slurry evaporators that have been supplied successfully. These high capacity systems produce a meal with very good digestibility, as well as good fat quality. They are highly energy efficient, but did not get good results on log reduction of BSE prion infectivity in European tests because of the very short residence time.

Fish Meal Systems

Although not employed in a large number of plants, this predominantly mechanical system is extremely energy efficient and, without a doubt, produces the highest quality fats and oils from any raw material that is possible to obtain. Capable of large capacity throughput and energy efficiency, their use may increase in the North American market in the future.

Low temperature separation is utilized for high product quality in finished meals and fat. The meals are still subjected to a long drying process, but the low temperature yields enhanced quality of fats due to a lower thermal stress.

Combination Systems and Retrofits

The innovation of the North American rendering industry is no more visible than it is in the various combinations of systems that have been created by connecting equipment from the different equipment companies. Combinations have been applied to provide the most economical, viable, and operable systems possible to process each combination of unique raw materials available to the industry.

Many companies employ pieces of equipment from various manufacturers, constantly seeking the best system to process the unique raw material stream they may have. There is no “one system fits all” in modern rendering. Selection of the “ultimate” system for each operation will continue to be a challenge in the future.

Managing BTUs

British thermal units (BTUs) are a way of measuring heat energy output. As any thermodynamic engineer will tell you, BTUs are BTUs, and they all cost money. Therefore, the loss of BTUs in any operating system is a revenue loss to the operating company. The paper industry is always held up as the best at hunting, capturing, and utilizing stray BTUs. The rendering industry has done a good job in the past, but success in the future will definitely depend on each company’s ability to use each BTU with the utmost efficiency. Energy will continue to be one of the top three cost categories in every operation.

Steam

As the main driving force in the evaporation of water from the raw material, steam is the single most costly part of the energy balance. Steam usage for the evaporation is a main consideration in the selection of a rendering system. As energy costs appear to be on the rise for the future, it is essential that steam usage be evaluated, controlled, and conserved. Any leak must be addressed immediately.

Hot Water Generation

Waste heat recovery through hot water generation is a major energy advantage to meat processors or others that have a need for large amounts of hot water on-site. The cost of hot water may outweigh the use of other recovery systems, and dictate hot water recovery as the best recovery method. Engineering a site for energy efficiency must include all of these comparisons.

Anaerobic Digestion for Methane Production

Rendering wastewater and condensate usually contain sufficient nutrients to necessitate further wastewater treatment. Anaerobic digestion not only reduces odor levels, but can provide valuable methane for use in the boiler system. Cost justification of biogas recovery and use becomes easier as energy prices soar. More systems based on this principle appear every year.

Availability and Choice of Fuel

The availability and choices of fuels can make or break success in locating a new plant, or retrofitting an old one. It is helpful to analyze and try to predict the variability in the future energy market. Any recoverable or recyclable fuel will be a plus. Risk management in the cost of energy will always be a challenge.

Stand-by or Alternative Fuel

As with the main fuel for a facility, the stand-by capacity must also be available in good supply. Without such consideration in the stand-by fuels, the facility may not be able to operate continuously.

Refuse Boilers

Environmental Protection Agency (EPA) regulations may or may not allow the choice of refuse boilers. However, the significant energy savings possible justify their consideration in the continual plant evaluations necessary today.

Heat Sink for Co-generation

Rendering plants are a perfect heat sink for cogeneration plants as they have a large steam requirement, and typically operate most hours in a week. A heat sink captures heat that would otherwise be wasted and uses it for production.

Waste Heat Thermal Oxidizers

A new facility must compare this option, especially if a zero-discharge facility may be required.

Using Fat as Boiler Fuel

In order to manage supplies and market gluts, fat can often be used directly as fuel in boilers on the same site at which it is rendered.

Nearby Opportunities

Collecting landfill gas for steam production and cogeneration of electricity is one way to capitalize on available alternatives.

Managing Quality

Much of this management has to occur at the source of the raw material, because the fresher, the better. Selecting the balance for economic viability is always a challenge. Cost of capital and geographic location will have the most effect on finished product quality. Selection of the processing system is also critical. Establishing the balance for individual company success creates the puzzle to be solved.

A number of other chapters refer to uses and suitability of rendered products for various purposes. The quality of that rendered product will determine its ability for a given purpose. Proper operation of the system selected is essential for achieving quality, as well as the raw material used for production. Nutritional uses will demand standards of production that guarantee high quality. Some non-nutritional uses have equally stringent quality requirements.

MIU (moisture, insolubles, and unsaponifiables) requirements have now seen further refinements. The 0.15 percent insoluble requirement for tallow from the OIE (Office of International Epizootics, now known as the World Organization for Animal Health) necessitates increased process techniques to achieve. New technologies will continue to be introduced, and rendering operations must continually embrace new developments in order to maintain the use of rendered products in as many areas as possible. Recovering the costs incurred by these upgrades becomes difficult.

Although expensive, refrigeration is still an alternative to manage the freshness of the raw material, and hence the quality of the finished products made from that material. Within an integrated facility of a meat processor, it is much easier.

Antioxidants in raw material play a key role in maintaining the quality of the finished products, especially in the poultry industry. When added to raw material, oxidation is retarded, and good quality pet food grade products can be recovered from a larger volume of the material. Of course, there is an added cost for these additives.

Bactericides can be effective in preserving raw material from degradation. No matter what method is used, retarding putrefaction results in higher quality products. Research continues in this and many other areas to provide solutions to everyday problems.

Raw Material

Selecting an operating system can be dependent on the freshness and type of raw material available. Downstream use is also dependent on properly processed raw material. Operating, maintaining, and constantly evaluating the "raw material collection system" is mandatory. And, as strange as this may sound, this holds true for on-site rendering at a meat processor. The cleanest, freshest, and most valuable raw materials can be ruined on-site, as well as being degraded due to weather, time of hauling, distance, and equipment breakdowns. Natural putrefaction begins immediately upon death, and there are no exceptions. Methods exist to retard this process, yet they also add to the cost and must be evaluated accordingly.

Regulatory Influence

Although the North American industry has been successful in cooperation with the regulatory agencies, it has not been without difficulty. As one of the most highly regulated industries before and after the advent of BSE, and after watching the European debacle, the industry has survived by continuing its proactive work with all of the regulatory agencies. Operations, and operating costs, can be influenced every day by the regulatory environment. Operations personnel must therefore be trained in the severe consequences resulting from non-compliance.

The availability of raw material for rendering can also be stopped by regulation. BSE has caused tremendous upheaval in rendering in many areas around the world. The "precautionary principle" will likely continue to alter the way the industry functions in the future.

Figure 2. Raw Material Receiving.

Evaluating a System from Beginning to End

Raw In-feed

Condition of the Raw Material: Consider worst case scenarios.

Type of Raw Material: A system can be modified if there are changes in materials (hard, soft, hair, blood, feathers, restaurant grease, other). Choosing a flexible system will reduce future costs.

Capacity of the System: Typical plans are made for full production plus cleanup each 24 hours. In a packinghouse environment, cleanup must occur each day to satisfy federal inspection requirements. If rendering is on the same site as slaughter and meat processing, a separate building may relieve the daily cleanup requirements, but cleanliness is still a requirement.

Capacity of Raw Material Holding Bins: Plans must be made to allow the incoming raw material to be stored with "buffer capacity" for fluctuations in volume. Requirements will vary greatly depending on the type of operation as well as the type of raw material. The cost of downtime to a meat processing facility has to be understood. Decisions on repair, replacement, and alternative means can only be made properly if good information is available.

Covered or Uncovered Bins: The latest designs in covered bins with hydraulic closure can help eliminate even more of the odors associated with the raw material. They are not mandatory, but offer an excellent opportunity to make a plant more fully enclosed and odor-free.

Product Storage Tanks: Storage logistics often depend on the geographic location of the plant. Heating coils and good insulation are mandatory for Minneapolis or Calgary, but these considerations are much different in Houston.

Confined Space Creation and Management: Work spaces such as tanks, bins, and pits, and their design mandate rules of use for confined spaces. Because of the possible accumulation of harmful gases, treat the area or item with respect. The Occupational Safety and Health Administration (OSHA) and other North American agencies have issued many guidelines for worker safety and health.

Bin Drainage: Raw material composition will dictate the level of drainage necessary in bins. Bin design will also impact their ability to convey any watery substance. Pumps can move liquids efficiently and can overcome some bin or pit design problems.

Floor Drainage: Scupper systems (a type of drain) added to the original building design will permit the most effective collection of liquids from the floor surface to be treated or reprocessed. Dry cleanup is preferred in meal areas, but liquids must be able to reach a collection pit or sump.

Truck and Floor Wash Waters: Plant economics drive the decision to either cook this protein-laden water, or deal with it in a waste treatment system. The level of sanitation required, biosecurity, and other disease or disaster issues may alter the need and method. For example, an animal disease outbreak may require a higher level of pathogen control.

Grinding Raw Material

Single Stage: Some grinding systems will allow one simple grinding step that fulfills all requirements of the raw material processed. It is important to make that decision in consideration of all of the parameters for the plant. Maintenance of close-tolerance grinders without metal detection can be extremely costly.

Multi Stage: Some process systems employed today require multiple grinding steps to achieve the optimum particle size. Slurry evaporator systems are a good example of systems in which small-sized raw material is necessary.

Size Control for HACCP-like Programs: Grinders require enhanced maintenance to produce consistent results. Any quality control system will include the grinding step as critical to process outcome. Ultimate particle size dictates the thermal efficiency of the system and is important to meet regulatory requirements.

Ease of Maintenance: Maintenance is always a decision factor, whether for raw material or finished product equipment.

Thermal Requirements of Regulations: Time and temperature may become part of the regulatory requirements in the future. These can be precisely controlled in modern rendering systems.

Pressure Cooking: This is a regulatory requirement in other countries as a disease control measure. Hair and feathers will continue to be processed with pressure cooking to improve digestibility and product quality.

Figure 3. Grinder/Pre-breaker.

Conveyance of Materials - Raw or Cooked

Cold Materials: Screw conveyors and pumps can be effectively utilized to convey cold products. Maintenance and cost of capital are part of the decision process.

Hot Materials: Cooked products can be effectively pumped, and pumps have become an alternative to conveyors for that purpose. This technology will continue to improve.

Salmonella and Other Pathogen Control: APPI has published many guidelines for the control of *Salmonella*. The rendering process effectively eliminates it, yet preventing meal from being re-contaminated continues to be challenging.

Conveyors: Construction is a critical factor and there are many levels of quality and construction. This can be one of the most confusing choices to make in a plant. Carbon versus stainless, longevity, and maintenance costs must be evaluated.

Pumps: Both raw materials and cooked products can be pumped effectively. The type, style, capacity, and material of construction should all be considered when a choice is made.

Distance Restrictions: Transportation costs have significantly reduced the service area of a rendering plant. This will certainly continue as energy costs escalate.

Cost Comparisons: The basic economics have to be carefully studied, and all variables must be evaluated in predicting the overall cost structure of the process.

Materials of Construction versus Cost: Longevity of equipment will make or break the financial model of a business. The ability of a constructed plant to outlive its depreciation schedule is important. Thin carbon steel screw conveyors, although very prevalent in initial construction due to costing, are not the economic answer in all cases. In fact, they may actually increase the cost of operation over the initial five years. Use of stainless steel and other alloys to increase the service life of equipment can be compared economically to achieve the most cost-effective mix for an operation.

Pressurization/Sterilization

Requirements for Regulations: Europe instituted pressure sterilization requirements to help stem the amplification of BSE. These requirements were intended to add extra logs of reduction in infectivity of contaminated materials. (Since BSE was not able to establish or amplify in North America, these requirements have not been instituted as of September 2006.)

Requirements for Optimum Use (Hair/Feathers): The keratin protein characteristics of feathers and similar characteristics in hair have necessitated the pressure hydrolysis of these products to increase their digestibility and amino acid availability to animals so they can be used as feedstuffs. Subjected to pressure over time, the tough protein bonds are severed, and the product is nearly indistinguishable from other protein meals.

Figure 4. Feather Cooker Hydrolyzers.

Cooking Step

System Dependent Characteristics: Different systems require different parameters in the cooking step to achieve good finished product quality.

Quality Control Parameters: Temperature, condensing capacity, fat content, and others must be used to control the quality parameters of the finished product. Some of these are due to inherent advantages or disadvantages of the system employed.

Heat Transfer Comparisons: Evaluating heat transfer must include the materials of construction of the heating vessel, as there are significant and insignificant differences in the metals used. Other factors such as longevity are also part of this economic calculation.

Operating Cost Comparisons: It is always good to have benchmarks to compare to when possible. Companies with multiple plants have access to such data. Single plant operations must continually compare only against their past performance. Using simple engineering calculations for BTU consumption is the easiest. However, the BTU consumption of electricity must be added to the BTU consumption of the steam or liquid heating in order to have an accurate comparison. Only then can evaporator systems be effectively compared to cooker systems in their overall efficiency. Theoretically you will not achieve better than 0.76 pounds of steam to evaporate a pound of water, and anything over 1.50 pounds may indicate poor efficiency. If you can achieve BTU usage of 800 BTU per pound of water evaporated, it is fantastic. Usage should not exceed 1,500 BTUs per pound of water evaporated.

Ease of Use: Control systems today are far advanced from the batch cooker days. Trend lines and nearly instant control have made a quality output easier to obtain. However, this does not eliminate the human factor that can introduce errors and variability in performance.

Multi-Stage Evaporators or Cookers: As capacity requirements increase, the size of the system must increase also. All of the considerations discussed in this and other chapters become inputs to these decisions.

Residence Time for HACCP-like Quality Controls: Modern systems allow easy tracking of time and temperature requirements needed to satisfy any regulatory authority as well as product quality specifications.

Particle Size Required by System Consistent with Preparation Step: In the selection of the operating system, particle size has to be viewed from beginning to end to ensure that all parts of the system have size requirements satisfied.

Drainage Post Cooking

Static Screens: Static screens can be effective for certain products, but provide difficulties with others. Each method has its proper place in modern systems.

Drainage Screws: Efficiency of drainage screws must be judged by their mechanical tolerance, drainage hole size, downstream fat handling, whether inclined or not, and other factors. The efficient separation of the fats and oils from the cooked product is a measure of profitability when the value of fat versus meal is considered.

Rotary Screens: In high volume slurry systems, rotary screens have been successful in fat separation and often have been less expensive alternatives to centrifuges.

Vibrating Screens: Their smaller size and high efficiency have proved effective in this separation step. Modern designs are leak-proof and made to easily control the vapors emitted.

Percolation Pans: All drainage options other than centrifuges are modifications of the original percolation pans used in front of batch cookers. The more modern means have proven superior to this old technology.

Centrifuges: In high-volume slurry systems, centrifuges have been used to make the initial separation before high-pressure pressing. Expensive in capital cost as well as operating cost, discussion of alternative means continues.

Waste Heat Usage

Evaporation: The use of waste heat evaporators on low yielding raw material will find favor when energy costs rise. Technology available today will continue to improve and be employed in plants as energy costs continue to escalate and yields fall.

Hot Water: Using steam to generate hot water gives an easily replaceable energy gain to any processor that has the cooker vapors available. Condensers to heat water are reasonable in cost, and the savings are substantial. Virtually all hot water needs of a processing plant can be met with the waste heat from an on-site rendering plant.

Other: Potential uses for waste heat include tank heating, raw material pre-heating, and building heat. Each plant and site will have a different matrix to use in their comparisons of energy cost and use to analyze in choosing equipment.

Pressing

Fat Residual Goals: High-pressure pressing comes with a relatively high maintenance cost. Therefore, good data must be kept to compare the myriad of choices that exist today.

Types of Presses: High pressure presses for cooked material are varied as much in size as they are in original equipment manufacturer. There are many good options. Careful evaluation of options and past practices need to be part of the selection process. Maintenance accessibility and wear part longevity dictate the economics.

Cost/Benefit Analysis: As more refined measurement systems have come into being, more data have become available for analysis.

Meal Fraction

Cooling: Cooling meal in a controlled fashion to prevent contamination with *Salmonella* and other pathogens can improve both yield and quality.

Sizing: Since customers have different requirements in their systems, the finished meal sizing will be varied as well. It may require separate systems for different customers or regular maintenance changes of screens and so on to comply with customer needs.

Grinding: A variety of choices also exists in the selection of the best means for grinding the product. Is the product ground hot or cold? Is a hammer mill, cage mill, or roller mill used? What does the customer want? What is the specification an industry standard, or a differentiation?

Classifying: High-quality, low ash, pet food grade meals can be achieved by classifying poultry meal. Raw material selection is also important. There are a number of different ways to physically classify the meal, including air classification.

HAACP-like Programs – Identifying Hot Spots for Pathogen Control: Post-process contamination of meals must be addressed in order to eliminate pathogens. This requires a system of timely maintenance to eliminate any "hot spots" where the pathogens can multiply. APPI education programs provide good insights into this issue and solutions.

Storage Capacities: The length of time lapse before finished products are shipped is important when planning storage capacity. Weather, geography, transportation, service availability, and natural disasters all affect that decision. Whatever the decision made, it will be soon tested. A balance must be made between risk and reward while considering cost.

Load-out Requirements (Trucks, Rail, or Container): A company's customer base will influence load-out capability. Capacity and speed of transfer are also important to satisfactorily service customers.

Figure 5. High Pressure Press.

Fats/Oils Handling

Settling Tanks: Allowing insoluble impurities to settle out is still one of the most successful means of achieving good quality finished quality fats and oils. Various washing techniques and additives are also available to achieve desired results.

Centrifuges: Whether horizontal or vertical, clarifier or polisher, two-phase or three-phase, centrifuges are the most common means of producing finished fats and oils with a low MIU result.

OIE Purity Requirements: The upper limit of 0.15 percent MIU set by the OIE for fats and oils in trade is prompted by BSE. Trade in the fats and oils should not be impeded if this specification is met. Contractually avoiding this requirement may not be allowed in the future.

Fines Handling: Centrifuges separate fines that will accumulate in tanks over time. Handling them immediately is the best quality solution, and the method used becomes yet another choice for the renderer.

Figure 6. Hammer Mill.

Figure 7. Centrifuge.

Tank Storage Capacities: As with the meals, the same criteria apply. Careful calculation and deliberation are necessary to meet the intended goals.

Load-out Capabilities: As with protein meals, the amount of time allowable before shipping impacts the planning of storage capacity as does weather, geography, transportation, service availability, and natural disasters.

Tank Designs (Heated Coils): Climate must be considered in tank design. Shape (whether cone bottom or not) is as critical as heating coils, recirculation pumps, and the piping configuration chosen. Ease of use and maintenance requirements are important.

Agitation: Exposing fats and oils to heated coils in a stagnant environment can degrade quality. Agitation can be a solution.

Odor Control

Air Scrubbing: This technology has been around for a long time and it is effective. Chemicals have changed, been modified, and have been specifically implemented for different sources of odor. Regulatory requirements can often be met with scrubbing systems.

Incineration of Odors: Incineration achieves the most complete destruction of odors. Thermal oxidizers, with or without waste heat recovery, are extremely effective in eliminating odors. The costs are substantial, but may be justified if a high volume of volatile organic compounds are present.

Biofilters: Biofilters are one of the most cost effective means of eliminating the odors associated with rendering. Properly designed biofilters include a good air humidification system. The medium used in the biofilter is also critical to the effective operation of the unit.

Waste Heat Incinerator Boilers: This form of heat recovery has become the accepted standard in Europe, and can also provide a means of creating a zero-discharge facility for wastewater.

Figure 8. Air Condensers on Roof.

Water Treatment

There are multiple choices for wastewater treatment. Fortunately, there are a large number of reputable firms that possess a good understanding of the wastewaters created by rendering processes.

Publicly Owned Treatment Works (POTW): A public system can be as much of a burden as a blessing if the plant cannot meet their discharge requirements. It bears mention that anyone going into a new city needs to physically evaluate the municipal system, no matter the representations made. The wastewater stream from rendering can prove to be more than the municipality can handle.

Direct Discharge: Obtaining a National Pollutant Discharge Elimination System (NPDES) permit is one of the most difficult items on a plant's list. Maintaining that permit, once obtained, is tantamount to the survival of the business at that location.

Zero Discharge: With the new waste heat incinerator boilers, zero discharge is possible, but at significant cost. Backup systems are required in the event of a problem, and the operating cost may prove prohibitive to evaporate some of the water streams. However, the cost to construct and maintain a wastewater system is far from insignificant.

Lagoons and Spray Fields: Under the new nutrient management plans required by EPA, lagoons and spray fields will still offer an acceptable alternative for wastewater management in the future. The nitrate loading in many of the first systems employed has surpassed critical levels and must be re-evaluated.

Nutrient Management Plans: Although the concept of nutrient management plans has been around farming for a long time, it was not given consideration because of the high concentration wastewaters generated by rendering. These may be useful in the future.

Novel Systems Created for Special Purposes

Enzymatic Hydrolysis: This may not be a novel concept, but it will continue to be evaluated for certain raw material streams.

Chemical Hydrolysis: Alkaline hydrolysis technology (WR^2) was designed as an alternative disposal method for contaminated tissues and dead animals, and it has certainly proven to be effective. The economic justification of such a system without government intervention will be difficult.

Mesophilic-Thermophilic Digestion: This process is a new two-step concept for treating municipal wastewater sludges. Much more research is needed in this area to adapt technologies to materials diverted away from rendering. Since most composting alternatives do not seem to provide sufficient pathogenic reduction, it is essential that this means of disposal receive some attention. Our society is also now forced to look at potential bioterrorism acts that could create huge disposal problems. We await that research with much impatience.

Major Equipment Suppliers

Anco-Eaglin, Inc. — www.ancoeaglin.com
The Dupps Company — www.dupps.com
HAARSLEV — www.haarslev.dk or www.atlas-stord.com

Equipment Suppliers

AC Corporation — www.accorporation.com
Advance Industrial Mfg., Inc. — jimwintzer@advanceind.com
Alloy Hardfacing & Eng. — www.alloyhardfacing.com
Andritz Bird, Inc. — www.andritz.com
Bliss Industries, Inc. — www.bliss-industries.com
Brown Industrial, Inc. — www.brownindustrial.com
Clapper Corporation — www.clappercorp.com
Crown Iron Works Co. — www.crowniron.com
DGA & Associates — dgaassociates@qwest.net
Duske Engineering — www.duskeengineering.com

Forest Air, Inc. — www.forestair.com
Frontline International, Inc. — www.frontlineii.com
Gainesville Welding & Rendering Equip. — gwrenderingequipment@alltel.net
Genesis III — www.g3hammers.com
Gulf Coast Environmental Systems — www.gcesystems.com
Industrial Filter & Pump Mfg. Company — www.industrialfilter.com
Industrial Steam — www.industrialsteam.com
KWS Manufacturing — ww.kwsmfg.com
Millpoint Industries, Inc. — millpnt@aol.com
Onkens, Inc. — www.onkens.net
Par-Kan Company — www.par-kan.com
Redwood Metal Works — www.redwoodmetalworks.com
Scan America Corp. — www.scanamcorp.com
SCP Control, Inc. — info@scpcontrol.com
Summit Trailer Sales, Inc. — www.summittrailer.com
Superior Process Technologies — www.superiorprocesstech.com
Travis Body and Trailer, Inc. — www.travistrailers.com
V-Ram Solids — www.vram.com
Weiler & Company, Inc. — www.weilerinc.com
Brandt Southwest Centrifuge — www.brandt-southwest.com
Centrifuge Chicago Corporation — www.centrifugechicago.com
Jenkins Centrifuge Company, LLC — www.jenkinscentrifuge.com
United Centrifuges — www.unitedcentrifuge.com
C.A. Picard, Inc. — www.capicard.com
Industrial Hardfacing, Inc. — www.industrialhardfacing.com

There are many engineering firms that also provide consultation to the rendering industry and specialize in certain parts of the process. Each company must select the combination they deem necessary to provide the results they seek. Many firms supporting the rendering industry are associate members of the National Renderers Association and are listed in the member directory on the Internet found here: www.renderers.org/Member_Directory/index.htm.

The Complete Business

Operating an independent rendering plant is indeed a complete business, with similar issues encountered in any business. Management, plant operations, air and water environmental quality, marketing, quality control, accounting, legal, and every other aspect challenge the renderer. Captive plants have the same issues, yet are a part of a larger entity that may centralize many of these areas.

Recycling is the renderers' way of life, as it has been for centuries since the first soap makers. Only after recycling was defined in the twentieth century were renderers ordained as the "original recyclers."