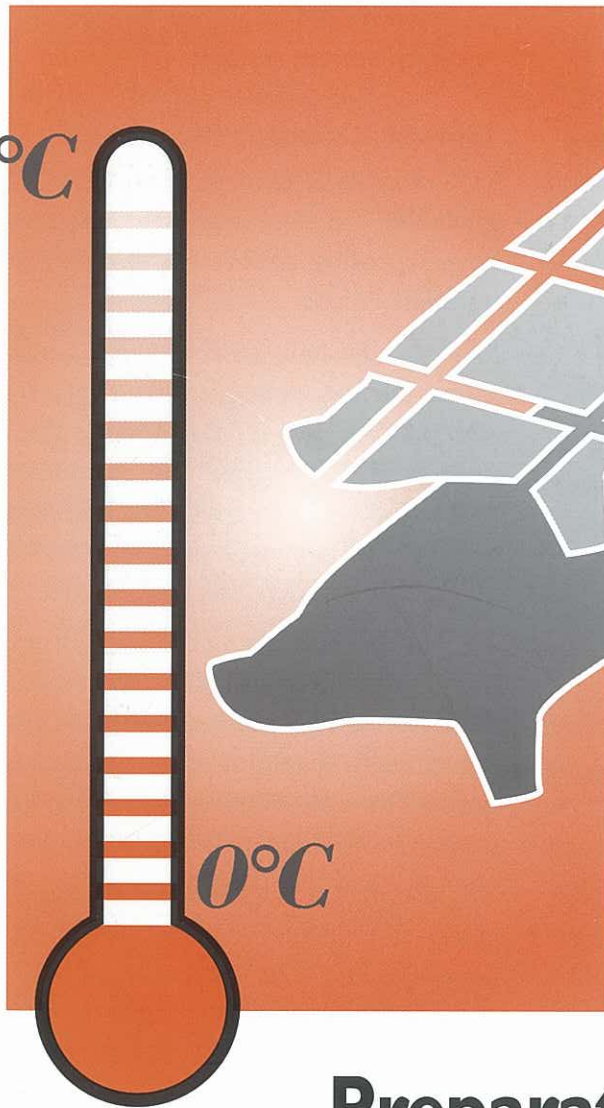


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# Preparation, Conveyance and Storage of Raw Materials

1997



Meat  
Research  
Corporation



**T**he size, cleanliness and freshness of material being supplied for rendering is vital to the production of quality meat meal and tallow.

A consistent size of material is required to achieve an even cook of all the product, and the material must be clean since this will affect the quality of tallow produced.

Two procedures which achieve this aim are size reduction and washing.

All size reduction machines are susceptible to damage from tramp metal to a greater or lesser extent. To minimise damage and reduce equipment downtime, machines should be protected by the installation of metal detectors or magnetic separators. The magnetic separators will readily eject ferrous metals such as skids and slides but have no impact on non-ferrous or stainless steel items.

### Hard Material Preparation

Hard materials for rendering include such items as heads, feet, horns and bones. Although these materials do not require subsequent washing, they need to be reduced in size. Unfortunately, the hoppers or pre-breakers required to break the material into more manageable sizes are expensive to purchase and run at "high" speeds using large electric motors. They can be damaged if a hook or metallic object falls into them.

Size-reduction machines may be sited at the kill floor, at the boning room or in the rendering section before or after the storage bins. When planning the raw material section, it is important, however, not to size reduce before necessary. Deterioration of the material quality accelerates considerably from this time because more surfaces are exposed to the air and contaminates.

Several factors determine the positioning of the reduction machines:

1. *The type of transporting system*  
i.e. mechanical or pneumatic conveying
2. *The type of rendering system in use*  
Generally, the material to a continuous system can be broken down immediately before entering the cooker. A batch plant should have sufficient storage, after the

reduction machine and close to the cooker, to enable speedy and efficient loading of the complete cooker charge.

### 3. *The amount of storage available*

Many plants have inadequate raw material bins and are forced to break down the raw material before storage in order to lift their total storage capacity.

### Types of Reduction Machines

Various types of material reduction machines are available. The main ones include the hog or hogger, pre-hog, pre-breaker, shredder and the traditional miner.

With an adjustable anvil or anvils mounted on the frame, the hog, or hogger, has a cylindrical drum with pockets, each holding a removable knife. The number of knives varies, and these knives rotate past and close to the anvil. The hog requires heavy maintenance, has a high noise level and is extremely vulnerable to tramp metal of any description.

The pre-hog also has a cylindrical drum, but, in this case, the drum is hollow and fitted with hard-faced horns. These horns pass through one or two sets of anvils spaced to give small clearance to the horns. The replaceable anvil teeth can be rotated to present four different cutting faces to combat wear.

The pre-breaker is a low-speed machine with radial cutters mounted on a central shaft. The cutters are positioned in a helix to impart horizontal movement of the product toward the outlet. Pre-breaker anvils are mounted at the bottom of the feed hopper, and in the barrel leading to the discharge throat which may be fitted with an orifice plate to give a more consistent product. Alternatively, multi-blade cutters are located in the discharge throat to reduce the size of hard bones. The product from the pre-breaker and pre-hog is usually of a similar nature.

The shredder has two horizontally mounted shafts which run in opposite directions at low speeds and with a speed differential. Special heat-treated cutters are mounted on each shaft. The cutters on the slower clockwise-rotating shaft deliver raw material to the higher speed anti-clockwise cutters to reduce the material to a manageable particle size.

The traditional mincer is used in low-temperature plants, usually after another machine such as a pre-hog or pre-breaker.

All of these machines have their advantages and disadvantages, and processors should evaluate each machine and determine what type of machine is best suited for a particular application.

### **Maintenance**

The most important aspect of operating reduction machines is the maintenance.

If properly maintained, the machines will cut cleanly and uniformly using minimum energy. If they are not maintained, the material will not be uniform in size and the machine will become more difficult to clean internally. Additionally, throughput will fall substantially, and the energy used will rise dramatically.

### **Soft Material Preparation**

The cutting of soft material reduces the material size and enables the manure to be readily removed during subsequent washing. To minimise fat loss, a positive, sharp cutting action is required, with the material immediately discharged from the cutters after the cut.

A good cutter should give clean cutting – not tear or grind – and should result in low fat disruption and little or no imbedding of manure into the tissue. If this is achieved, less fat goes down the drain during washing. (For each half-tonne of pea fat floating down the drain each day, another half-tonne is often only partly retrievable from a dissolved air flotation unit, and unretrievable from a Saveall.) In addition to fat being lost, protein is being washed down the drains.

Commercially available cutters generally fall into four categories:

1. Disc type
2. Hoggers
3. MIRINZ-type cutters
4. Gut cutters

**Disc-type** In the disc hasher, two sets of overlapping circular blades rotate toward each other at different speeds. One set has a notched cutting edge, and the other on the high speed shaft has a smooth cutting edge. When raw material is dropped into the hasher, it is dragged through the machine by the notched blades and sliced by the smooth blades.

Disc hashers perform their primary function well but they have three main disadvantages. Firstly, because constant maintenance is required to keep the discs sharp, they are prone to damage from skids, etc. Secondly, their capacity is limited, especially on full beef paunches and bibles. The third main advantage is that, when the gut material is hashed, a pea fat is generated and subsequently lost to the Saveall.

To minimise maintenance and increase throughput capacity, a trial involved replacing the high-speed knives on some disc-type machines with notched (saw) blades. While the desired objectives were achieved, the quantity of pea fat generated due to the increased tearing action was unacceptably high. As a result, this modification is not recommended.

**Hoggers** Because horsepower can be increased to boost capacity as required, hoggers have greater capacity than disc machines.

The action of the hogger is unsatisfactory, however, because it imbeds manure into the tissue, and produces excessive chip fats which go to effluent.

**MIRINZ-type cutters** This third cutter was developed specifically to overcome the problem of heavy fat losses in the hasher washer area. This was achieved by designing a true cutter with anvils. However, due to the close tolerance between the cutters and anvils, this type of cutter is particularly vulnerable to damage from tramp metal.

**Gut cutters** Modified Brentwood shredders have been developed for soft offal cutting. Cutters mounted on contra-rotating shafts carry the material to anvils located on either side of the housing where it is cut with a scissor-like action. The gut cutter can be coupled to a high-pressure washer where nozzles are mounted in the discharge chute and directed inward so the cut material is effectively washed as it falls through the spray.

### **Washer**

The washer, unfortunately, is often a neglected area in the total rendering operation.

The washer is generally a perforated rotating screen. It should be equipped with an inside and an outside spray line.

With correct pressure – lower pressures give minimal fat loss – and spray angle, the cold water on the inside line will efficiently flush the manure from the hashed viscera but will not wash excessive amounts of fat to the catch basin. However, because the viscera fat will build up on the inside of the cylinder and clog the perforation, hot water (50°-60°C) is needed on the outside to flush this away so manure and dirty water are removed.

The trommel should be operated so the residence time in the trommel gives sufficient time – as determined by the length, angle and speed of rotation – to effectively wash then drain the material before it goes to the renderer.

### Particle Size

Consistent particle size is the most significant factor in ensuring a standard result and in preventing a fines problem. When particle size differs greatly, the time required to cook the larger pieces causes the smaller particles to be reduced to fines.

A small consistent particle size requires a short cooking time at the lowest practical temperature. This will produce a consistent end product, keep processing costs down and save wear-and-tear on the cooker.

If the particle size is too large, it is difficult to cook the cracklings evenly. Large particle size of raw material also gives less free-run tallow – tallow that separates freely from the cracklings before an extraction machine such as a press, and which is the best quality tallow.

If the cracklings are fed to a press, the press uses extra power to break the large pieces. If a basket centrifuge is used, extra power is used at the mill to break down the material. The capacity of the press and the mill – and the maintenance cost of each machine – will suffer accordingly.

Raw material can be broken too finely, but this is not caused by the reduction machine. This condition may be caused by decomposition if the material is too old by the time it arrives in the plant. The raw material virtually degenerates into fines in the cooker. Excessive fines are also generated if material is kept in the cooker too long.

Some operators believe that gut must be broken to a smaller and more uniform size than hard material. The theory behind this is that, with

smaller particle size, heat is transferred through the material more quickly and tallow bleachability can be kept to an acceptable level. This probably applies more to the service renderer where, because of the time lag between the kill floor and the rendering factory, a problem is created before the material reaches anywhere near a hog or pre-breaker.

### Conveying Raw Material

The method of conveying raw materials to the rendering plant from the various departments in the works contributes significantly to the efficiency – and therefore the economics – of a rendering operation.

Raw material is conveyed in several different ways: skips and barrows, mechanical, water-chute, pumping, blow, trucking and cleaning.

**Skips and Barrows** This system has the cheapest capital cost but is very labour-intensive, slow and causes difficulty in loading and unloading material.

**Mechanical** Although screw conveyors are commonly used to convey raw material, they are relatively expensive. Generally, screw conveyors are ideal for distances of up to 15-20m when the conveying path has no, or few, changes in direction. A common problem with these conveyors is that long strips of soft offal can get wrapped around the shaft of the conveyor. This problem can be avoided by using large-diameter shafts (75-100 mm). Soft offal is best transferred, however, by pneumatic systems.

Cleaning screw conveyors is also a problem because very large amounts of water are frequently used to hose them down. (A better method would be to have water jets built into the cover of the screw conveyor.)

Additionally, the mechanical agitation and churning action of these conveyors tend to disperse enzymes throughout the raw material. This leads to increases in the free fatty acids (FFA) of the raw material, and the finished tallow reflects this increase. Although belt conveyors do not agitate the raw material, they cannot cope with steep inclines.

**Water-chute** This method is used generally to convey hard material – heads and trotters – and,

in some instances, viscera. With water-chute conveying, raw material is lost because significant amounts of fat and proteinaceous material dissolve in the very large amount of water used.

**Pumping** Pumping is the least costly method of conveying, but this method has several disadvantages. Positive-displacement pumps, such as Mono pumps and lobe pumps, can be used to move raw material with little or no addition of water. If the raw material is liquid enough, open impeller pumps can be used. As with screw conveyors, some pumps churn the raw material thus dispersing enzymes. Pumps could also cause emulsification and create excessive losses of fat and protein.

**Blow** This method is relatively economical and can transport both soft and hard material. As with screw conveying, the mechanical shock imparted to the raw material could disperse enzymes. This problem can be overcome to a large extent by using large diameter pipes (150mm) and avoiding excessively high pressures.

The main problem with pneumatic conveying systems is poor design and/or operation. Because of the large volume of compressed air required, the inlet valves to the blow tank are usually generously sized and, if fully opened, can result in excess pressure build-up before the material begins to discharge. As a result, water is often used to minimise blockages and facilitate transfer ( a practice which increases instability of materials for rendering and causes problems in storage and in rendering itself.

Steam is often used to loosen or soften raw material prior to transfer by a pneumatic system. The heating is usually non-uniform, resulting in pockets of high and low temperature within the charge, elevating the temperature sufficiently to further activate enzymes and increase free water.

These inherent problems can be minimised by a combination of the following actions:

- Regulate the air inlet valve so the material discharges at the lowest practicable pressure.
- Shut the valve when there is just sufficient residual air volume in the tank to totally evacuate the line. This minimises impact in the discharge cyclone which would further

degrade the raw material, and it reduces the air consumption and running costs.

- Regulate the quantity of water added during each blow charge. This will depend on the raw material mix and layout of the pipeline. A small tank mounted above the blow tank can dump a measured volume before material is added. The water plug moves ahead of the material and lubricates the blow line to reduce friction.

**Trucking** When raw material is transported by road, care should be taken to minimise the addition of water and to ensure that the temperature of the raw material does not rise during transport. If high ambient temperatures make this impracticable, acid can be added to preserve the raw material and inhibit the rise of FFA.

**Cleaning** All conveying systems must be cleaned thoroughly with hot water at the end of each day's production. Dry cleaning and removal of all particles is recommended before wet cleaning is commenced. Wash water should not be left laying in troughs.

### Storage of Raw Materials

Raw materials for rendering are highly perishable and should be rendered soon after they have been prepared. If unforeseen circumstances result in prolonged storage of raw materials, however, the raw material can be preserved by following certain steps.

Ideally, the residence time of raw material in the storage vessel should not exceed 2 - 3 hours. Hogged bones are quite unstable and deteriorate rapidly. The fatty acid content of the fat in hogged bones may double within 6 hours' storage. Hashed or hogged gut offal presents a more challenging situation and cannot be stored long without special preparation.

Whole fresh bones and fat trimmings are more stable and can be stored for 4-6 hours at ambient temperature (20°-25°C) without severe degradation. Whole intestines, on the other hand, will not last quite as long but are much more stable than if they are hashed or hogged.

Stored raw material should be dry. Water promotes deterioration and increases the volume

of raw material requiring larger storage capacity. It also increases the evaporative load in dry rendering and produces excessive quantities of stick-water in wet rendering systems.

One expedient if rendering delays are avoidable is to preserve the raw materials chemically. Two methods are available for preservation: 1) the addition of sodium chloride or 2) the addition of dilute hydrochloric or sulphuric acid.

Unpreserved raw material should not be held over until the following day for processing. It should be rendered, or at least partially cooked, to stabilise it (approximately 1 hour's cooking time).

The potential for market resistance to meat meal in poultry rations because of biogenic amines in meat meal was identified in the MRC's Rendtech Compendium of rendering technologies. Biogenic amines, products of the breakdown of proteins, are found in many foods and can contribute undesirable flavours to food and animal feeds. Biogenic amines are suspected of causing losses in poultry which were fed rations containing ingredients with high levels of biogenic amines.

It is likely the levels of biogenic amines in meat meals are related to the degree of decomposition of raw materials before cooking, rather than the type of cooking.

### **Storage Vessels**

Because material is drawn from the base of the vessel on a first-in, first-out basis, cylindrical, conical-based, vertical storage vessels which are tall and slender rather than shallow and wide are preferable. Another advantage of this shape of storage vessel is that it saves floor space.

A storage vessel must be designed for easy cleaning and should be placed in close proximity to the final size-reduction equipment and the cooker. The container doesn't need to be inside the building, but should be weatherproof if located outside. Some storage vessels have steam coils fitted so the raw material can be pasteurised if delays occur.

Having multiple storage vessels may be more expensive, but having more than just one container allows for separate storage. Subsequently, controlled blending of different types of raw materials is possible.

Many raw material holding vessels are poorly designed and do not work on a first-in, first-out basis. A long and relatively shallow bin design allows offal from the rear of the bin to be picked up preferentially by the auger, and carried beneath the stored material in the bin. An attempted solution has been the use of variable pitch screws, with pitch increasing toward the discharge and distributing feed over the full length, hence avoiding stagnant areas. The practical success of this design is debatable.

Alternatively, twin screws feeding in opposite directions can be used to agitate and blend the raw materials for even feed.

Arching occurs when the raw material bridges over the discharge auger, forming a hollow core, and reduces or halts the discharge of material from the vessel. This problem is common in vessels designed with two shallow, sloping sides and can be alleviated by having one vertical and one sloping side. Single or multiple large diameter screws prevent arching, but may result in excessive volumetric discharge rates. This creates the need for low-drive speeds and large diameter shafts.

### **Storage Temperature**

Ideally, raw material temperatures should be kept below 10°C or above 65°C. Deterioration of the raw materials through bacterial and enzymic action is halted at temperatures above 65°C.

Although reducing the temperature of the offal to 10°C or below would ensure the offal was fresh at the time of rendering, this practice would not be economical.