MIRINZ
MEAT RESEARCH

No. 33

June 1996

BULLETIN

BEEF PAUNCH PROCESSING

In New Zealand, beef paunches are usually manually slashed, then emptied by wet-dumping before further processing. A few plants, however, empty paunches by dry-dumping. This Bulletin describes how these two paunch handling systems affect waste treatment loads.

One of the best ways a meat plant can reduce its environmental impact and waste treatment costs is to reduce the production of pollutants at source.

As commonly practised in New Zealand, beef paunch processing can produce large volumes of effluent containing a significant pollutant load.

PAUNCH PROCESSING

Beef paunches may be processed for recovery of edible products, used for pet food production, or rendered.

Clearly, the paunch content material (PCM) should be emptied out if paunches are to be used for human or pet food. However, even when paunches are simply sent to rendering, they are normally emptied first. Otherwise the paunch material (usually partially digested grass) will reduce the protein content of the meal, degrade the tallow quality, and increase rendering costs.

Thus, before any further processing, beef paunches are typically slashed open manually, and emptied of their contents. The paunch solids are then usually either put in sludge lagoons, applied to land or composted. (See MIRINZ Bulletin No. 23.)

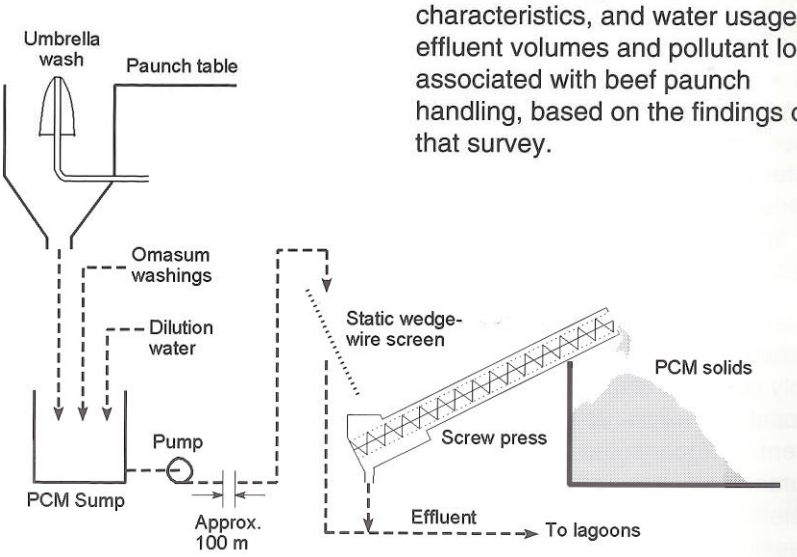
The PCM has high concentrations of a variety of pollutants, including total solids (TS), total suspended solids (TSS), total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N) and total phosphorus (TP). The organic material in the PCM gives it a high chemical oxygen demand (COD) and five-day biochemical oxygen demand (BOD_5).

Components like nitrogen and phosphorus are plant nutrients. When paunch material is composted or applied to land, the presence of these nutrients in the solids is useful, because they promote plant growth.

On the other hand, these nutrients and other pollutants in the paunch material should be kept out of the liquid effluent stream, because they can contribute to nuisance plant growth and other problems if released into receiving waters. Once these contaminants have entered the liquid stream, treating the wastewater to remove them can be costly.

TWO PROCESSING SYSTEMS

In New Zealand, beef paunches are usually emptied by either washing out their contents (wet-dumping) or allowing the contents to drain out (dry dumping). Most New Zealand plants wet-dump the paunch contents.



Example of a wet-dump paunch-handling system.
(Plant A in the MIRINZ study)

Condemned paunches are an exception to the usual practice of paunch emptying—they are commonly sent to rendering unopened.

At a few plants, however, condemned paunches also contribute to the waste treatment load. At these plants condemned paunches are macerated in a gut cutter, along with the other viscera. The macerated tissues are then washed in a gut washer.

Washing produces a good-quality material for rendering, but increases the volume of effluent and mass of pollutants entering the waste treatment system.

PAUNCH HANDLING STUDY

MIRINZ recently surveyed paunch handling operations at four typical New Zealand beef plants. The survey examined two wet-dump and two dry-dump systems.

The remainder of this Bulletin discusses beef paunch content characteristics, and water usage, effluent volumes and pollutant loads associated with beef paunch handling, based on the findings of that survey.

PAUNCH MATERIAL CHARACTERISTICS

The characteristics and volume of the paunch contents can vary greatly from animal to animal. A major factor influencing this variation is animal holding time at the plant before slaughter.

Paunches of animals that are slaughtered shortly after they arrive at a plant typically contain a large amount of relatively dry material. As the holding time before slaughter increases, the amount of paunch material decreases and becomes more liquid, especially if the animals have access to drinking water.

Other factors likely to affect the amount and characteristics of the paunch material are the type and age of the animals, and the type of feed.

WET-DUMPING

Wet-dumping, although allowing the recovery of edible products, uses a large amount of water and therefore produces significant volumes of effluent. As well, many plants using wet-dumping convey the paunch content/wash water mix out of the processing area by pumping. These plants often add even more water, to prevent the pump from blocking.

The waste stream from a wet-dump system is a slurry, which is then screened to remove the gross solids. As the large volume of water used in a wet-dump system passes through the screen, it carries with it much of the dissolved and fine particulate pollutants in the slurry. These then enter the liquid effluent treatment system, where they contribute a significant load.

Wedge-wire screens with apertures of 0.5-0.75 mm are commonly used. Larger apertures would allow a greater amount of particulate material to enter the effluent stream; finer apertures could result in excessive blinding of the screen.

The large volumes of water used in wet-dump systems not only have a supply cost, but also a treatment and disposal cost. If plants treat their effluent in lagoons, the added pollutant load from wet-dumping accelerates sludge accumulation, increasing the costs of desludging.

SURVEY OF PAUNCH HANDLING OP

PLANT DESCRIPTION

MIRINZ recently surveyed beef paunch-handling operations at four beef plants—two using wet-dump and two using dry-dump systems.

Diagrams of the paunch-handling systems at all four plants are shown in this Bulletin. All animals processed had been pasture fed.

At all four plants condemned paunches were sent whole to off-site rendering.

Wet-Dump Systems

Paunch processing at the two wet-dump plants was similar. The omasum was removed, then the paunches were manually slashed, drained, and cleaned using an umbrella wash. The omasa were cut in half and washed in a proprietary paunch cleaning machine. Edible products (omasum, tripe and mountain chain) were recovered.

The paunch content material (PCM) was dewatered in a screw press, then composted. The liquid effluent from paunch handling went to waste treatment.

Dry-Dump Systems

At the two dry dump plants, the paunches were manually slashed, and the paunch contents were dumped into a hopper without washing out the sac.

The paunch sac and whole omasum were taken off site for rendering and/or pet food production, and the paunch contents were either dewatered in a screw press (plant C) or the liquid in them was allowed to drain through a screen (plant D).

Only a small quantity of water was added to either system. This water was used to wash out paunch collection hoppers, or assist conveyance when the paunch material was very dry.

SURVEY RESULTS

Water Use and Effluent Volumes

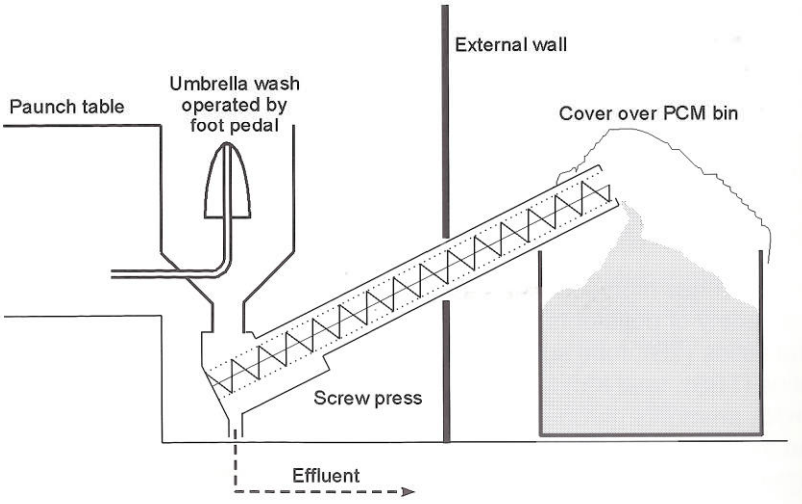
The two wet-dump systems used large volumes of water and produced about 390 litres (plant A) and 240 litres (plant B) of effluent per paunch, which equated to 21% and 14% of the total plant effluent, measured on a per animal basis.

The effluent volume at plant A was especially large because water was added to the PCM to aid pumping, and omasum wash water contributed to the effluent.

In contrast, the two dry-dump systems used little water and produced only small volumes of effluent per paunch (<20 litres). This effluent consisted of PCM liquid as well as the small amount of water used in these systems.

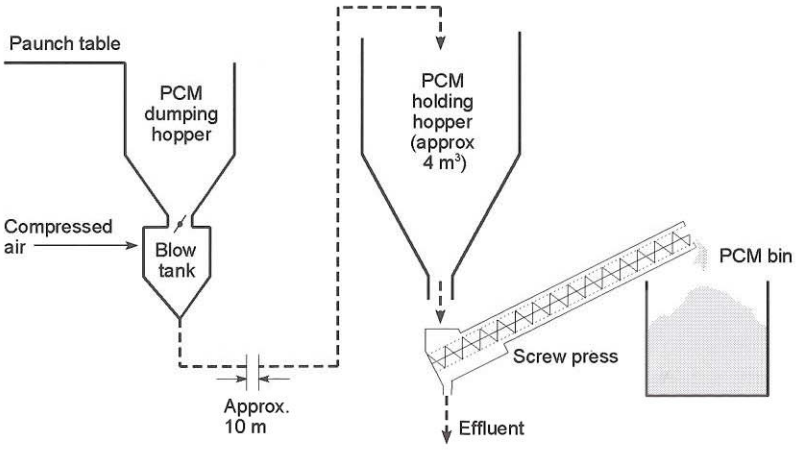
Effluent Characteristics

In the wet-dump systems, over half the total solids (dissolved and particulate) and over three-quarters of the nutrients in the paunch content material were washed through the screens and into the effluent.



The wet-dump system at plant B.

ERATIONS AT FOUR MEAT PLANTS



The dry-dump system at plant C.

By contrast, in the dry-dump systems, no more than about one-fifth of the total solids and less than half of the plant nutrients in the paunch contents entered the liquid waste stream.

Wet-dumping contributed a significant proportion of the plants' effluent load, compared with dry-dumping, as shown in the table, below.

TWO-STEP TRIAL SYSTEM

Paunch handling at one of the dry-dump plants (plant D) was briefly modified into a two-step trial system in which the contents of the paunches were dry-dumped, then each paunch was washed thoroughly, using a hand-held water sprayer.

On average, after the dry dumping stage, 10% of the TS, 14% of the TKN and 11% of the TP in the paunch material remained in the paunch sac. These were washed out during the spray wash.

About 48% of the total solids in the spray wash effluent was removed by screening the effluent through a 1.2 mm screen.

Paunch processing effluent volume and characteristics for four paunch handling operations. (Plant A data include the effects of the omasum wash.)

	Wet-Dump		Dry-Dump	
	Plant A	Plant B	Plant C	Plant D
Effluent characteristics				
Effluent volume (l / paunch)	389	241	19	7.3
TS (g m^{-3})	6700	9900	29300	34800
TSS (g m^{-3})	5400	5100	13500	19300
COD (g m^{-3})	8000	8500	32500	38200
BOD_5 (g m^{-3})	3200	1900	8600	14200
TKN (g m^{-3})	240	280	1100	1900
NH_3-N (g m^{-3})	19	26	210	610
TP (g m^{-3})	82	120	600	630
Proportion of paunch content components in screened paunch effluent				
TS (dissolved and particulate)	57%	65%	19%	6%
TKN	77%	77%	31%	11%
TP	84%	88%	41%	15%
Contribution of paunch effluent to total effluent loading of a typical plant (plant B)				
TS	42%	38%	9%	4%
TSS	57%	33%	7%	4%
COD	48%	31%	9%	4%
BOD_5	46%	17%	6%	4%
TKN	24%	18%	6%	4%
TP	55%	52%	19%	9%

With aerobic lagoons, the added load also increases the aeration demand during treatment.

For plants that irrigate their effluent, MIRINZ estimates that the nitrogen demand due to wet-dumping of beef paunch contents could increase the amount of land area needed by 20%.

Ideally, wet-dump systems should use only enough water to wash out the paunch sac and should use gravity drainage rather than pumping for conveying the waste slurry. MIRINZ found that one plant that wet-dumps and washes paunches by hosing typically used only 145 litres of water per paunch.

DRY-DUMPING

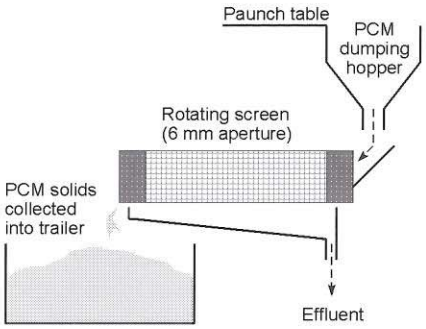
Few plants in New Zealand dry-dump the paunch contents. In terms of effluent pollution-control, dry-dump systems are preferable to wet-dump ones. However, dry-dumping alone does not allow the recovery of edible product. Examples of dry-dump systems are shown, above left, and on the back page of this Bulletin.

Dry-dump systems use no water to help remove the paunch solids. Instead, the paunch material is simply allowed to fall out of the opened paunch. The paunch sac is then either rendered or processed into pet food.

The dry-dumped paunch material is generally a slurry (8-10% total solids content). The slurry is usually dewatered, for example by screw press or screening, so it can be handled more easily during transport for disposal. This dewatering produces an effluent that needs treatment. Dry-dumping also produces more solids needing disposal/utilization than wet-dumping.

The effluent from a dry-dump system tends to be much more concentrated than that from wet-dumping, but because much less effluent is produced, the total amount (mass) of pollutants entering the waste treatment system will be much less than for wet-dumping.

The extent of dewatering of the dry-dumped material has a marked effect on the effluent loading: greater



The dry-dump system at plant D.

dewatering means higher loadings. Thus, the degree of dewatering should be kept to the minimum needed for effective transport and disposal/use of the solids.

Because dry-dumping retains most of the pollutants in the dewatered paunch material, extra care is needed during subsequent handling of this material, to avoid generating nuisance odours or uncontrolled leaching of nutrients from it.

A POSSIBLE ALTERNATIVE

An ideal paunch processing system would minimize water usage, reduce the amount of paunch material pollutants entering a liquid waste stream, and allow recovery of valuable edible products. A two-step system in which the paunches are dry-dumped and then spray washed has the potential to meet these criteria. This type of system was proposed many years ago but is not yet used in New Zealand.

Based on the survey results, MIRINZ estimates that changing to such a system from a wet-dumping system could reduce paunch effluent pollutant loadings by more than two-thirds, and the effluent would be much easier to pump and screen. Water usage and effluent volume may also decrease.

As with a dry-dump system, the extent of dewatering will affect the effluent loadings and volume—greater dewatering will increase both, but never to the extent seen with current wet-dump systems.

The dry-dump / spray wash system could be implemented by using separate dry-dumping and spray wash basins, or by having a single basin with a pneumatically controlled flap in the base directing the paunch solids and spray-wash effluent to separate collection systems (see figure below).

TAIL-GATE SLAUGHTER

A dry-dump or dry-dump / spray wash system, when combined with tail-gate slaughter (slaughtering animals "straight off the truck"), would allow more of the animals' digestive system contents to be collected from the paunch in a "dry state", for beneficial use as a fertiliser or compost.

Tail-gate slaughter benefits waste treatment by reducing the effluent load from the faeces and urine released by animals during lairage.

Currently, the only option for handling these wastes is to wash them into the plant's effluent treatment system during cleaning of the holding pens.

Tail-gate slaughter also benefits meat quality and animal welfare by reducing the opportunities for preslaughter stress and bruising.

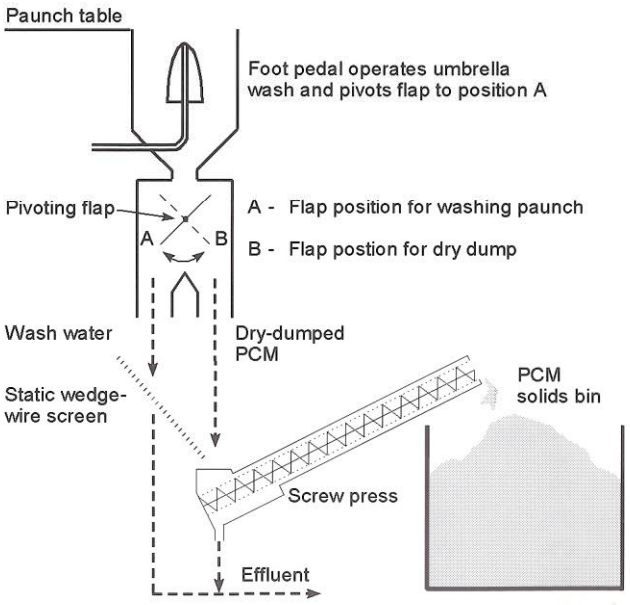
CONCLUSIONS

MIRINZ estimates that converting a wet-dump system to a dry-dump or dry-dump / spray wash system could reduce total plant effluent pollutant loadings by about 10-45%, and potentially reduce treatment costs by a similar amount. Unfortunately, at many plants the design of the paunch room is such that such conversion would be difficult.

Another major consideration is the relative cost of disposing of PCM as "solids" compared with that of disposal via the effluent treatment system. Plants with a low-cost option for managing PCM solids and high effluent treatment costs would gain most benefit from adopting a system that uses dry-dumping.

FURTHER READING

Evaluation of Beef Paunch Handling Practices by A.J. van Oostrom and R.W. Muirhead, MIRINZ Technical Report No. 967.



Example of how a two-step dry dump / spray wash system might operate.

Production of this bulletin was funded by the New Zealand Meat Research and Development Council.

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