Cleaner Production in Beef Production	Australia	-	Full scale

MANUFACTURE OF FOOD PRODUCTS AND BEVERAGES # 3

http://www.emcentre.com/unepweb/tec_case/food_15/process/p18.htm

Background:

Australia Meat Holdings (AMH) is the largest producer of beef in Australia serving the domestic and export markets. AMH operates 8 abattoirs (slaughter houses):

- Portland, Victoria
- Brisbane (Dinmore), QLD
- Aberdeen, NSW
- Toowoomba, QLD
- Guyra, NSW
- Rockhampton, QLD
- Beaudesert, QLD
- Townsville, QLD

Note: Subsequent to the preparation of this report, the three plants at Portland, Guyra and Beaudesert have ceased operations.

AMH has positioned itself as a market leader in the Australian beef industry. During the last 12 months the sites processed around 1 million head of cattle across the 8 abattoirs. The major products are boned, chilled and frozen beef sections, together with lesser quantities of tallow and by-product meals. This has been applied to all facets of the operation, through work place employment agreements, work place health and safety and operating practices for the premium grade export market. The company is closely aligned with industry bodies and associations including:

- CSIRO
- Meat Research Council of Australia (MRC)
- Meat Research Institute of New Zealand (MERINZ)

Cleaner Production Principle:

Process modification; Housekeeping.

Cleaner Production Application:

AMH uses the traditional method meat processing and is briefly described below:

Slaughter	The animal is first washed to remove body dirt before being stunned, and bled. The hide is then removed followed by the paunch. The carcass is then trimmed and cut lengthways into two sides of beef. The paunch material is sorted with saleable product being removed and waste material being transferred for rendering.
Chilling	The sides of beef are then chilled down overnight.
Boning	The beef is de-boned and sectioned before packaging.
	The packed beef is packed either held in chilled storage, or is frozen.

At all stages of production the meat is inspected both visually and using scanning techniques to maintain quality standards.

Cleaner Production Approach at AMH

The Cleaner Production Project was initiated in all the abattoir operations. A structured approach was used in the identification and implementation of Cleaner Production at AMH, as follows:

- Initial "audit" of the site, conducted by Energetics in close discussion with AMH personnel. The purpose of this audit was to provide preliminary information on the operation of the site, and identify general cleaner production opportunities.
- Follow up site visits and meetings, with the objective of reviewing site processes in more detail, and identifying specific cleaner production opportunities with potential to become cleaner production projects.
- Evaluating the benefits and costs associated with each of the potential cleaner production projects.
- Selection of the project(s) to be implemented on site.
- Implementing the selected project(s) and conducting any monitoring required demonstrating the benefits of the project(s).

During the initial site audit and through discussions with the AMH Cleaner Production Team a number of potential cleaner production opportunities were identified. These projects involved improvements in:

- offal cutting and washing;
- blood processing; and
- coal boiler performance.

To maximise any potential benefits and due to the similarity of each abattoir operations, the AMH Cleaner Production Team tried to identify cleaner production opportunities which could be applied to most if not all of their abattoirs.

Therefore, the opportunities were not site specific. The identified opportunities are discussed in more detail below.

1. Improvement of Wastewater Quality

To maintain the highest levels of cleanliness, two to three megaliters/day of warm and hot water is used at typical abattoirs for cleaning and sterilising equipment which becomes contaminated with protein and fat. Only one of the AMH abattoirs is permitted to dispose of this water to a council sewerage system, so on-site treatment and irrigation of onsite pastures is commonly used.

Wastewater treatment techniques include flotation, aerobic and anaerobic systems, which are used to break down the proteins solids to simple elements. These systems include large water storage dams plus pumping and agitation systems. The running costs are generally low except for electricity, which is used for hydraulic pumping and agitation. Within the aerobic system considerable electrical energy is used for aeration of the wastewater to stimulate microbiological activity. The energy consumption is proportional to the amount of work that the biological system has to do, therefore the lower the concentration of pollutants in the waste water, the less work the aerators are required to do, and most importantly the smaller the treatment system and the less energy used. Pollutant loading of the wastewater is determined by the total flow of wastewater and the concentrations of:

- Biological Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- Non Filtrable Residue (NFR); and
- Total Kjedahl Nitrogen (TKN).

From an early wastewater audit it was found that two processes contributed to the majority of the wastewater stream fat and protein loading. These are:

- Offal cutting and washing; and
- Blood water.

The early wastewater audit found that there were significant differences in the organic/protein loading of these two waste streams at the different abattoirs. Therefore, identifying efficient cleaning practices and standardising procedures across each abattoir could make significant improvement made at some abattoirs.

Offal Cutting and Washing

The reason for cutting and washing the material is to produce manageable pieces (fist size) of offal which have been washed to remove any retained paunch grass. It is paunch grass that if rendered will discolour the tallow, reducing its market value.

Different types of cutters are used around the AMH group, briefly these are:

Hogger:	This device contains a drum on which hook-like blades are set which rotate against a fixed anvil. Material is fed into the hogger which is ripped into small pieces that pass through to the trommel. The trommel is a rotating mesh drum through which the chopped offal is screw-fed. Water supplied from a spray bar, washes over the offal and is drained through the mesh.
"MERINZ" Cutter:	This cutter operates rotating blades against anvils which create a shearing action on the material.
"BRENTWOOD" Cutter:	This uses counter rotating blades which shear/rip the material.

The differences between the three cutters were thought to be crucial in accounting for the differences in the amount of fat and protein lost during washing. The washing of offal prior to the rendering process was also thought to affect the amount of fat and protein lost and the resulting by-product quality.

Any potential opportunities in the offal preparation and washing areas would be aimed at reducing the organic, and nitrogen loading in the wastewater.

The benefits of reducing the organic and nitrogen loading in the wastewater streams are:

- Lower capital cost for ponds and aerators;
- Reduced maintenance costs for aerators;
- Lower mains water usage;
- Reduced trade waste charges (where council sewerage in place);
- Reduced manpower; and
- Reduced energy costs.

To assist in the cost/benefit assessment of any initiative, an assessment of energy costs of the water treatment would be required. The following is the baseline data used for calculating the energy currently consumed by the agitators for wastewater aeration.

Typical 600 head per day operation	
Base Data	300 kg/day ammonia (NH_3) (over 24 hrs) i.e., 12.5 kg/hr 1 kg NH_3 requires 4.53 kg O_2 Aerator 1 kWh-hr produces 1.6 kg O_2
Energy Required	
Per kg NH_3	2.83 kWh/kg NH_3

Per kg NH_3	2.83 * 12.5 = 35.4 kWh
Total shaft power	35.4 * 24*7*50 = 297,360 kWh pa
Total energy	@ 8ckWh= $23,789 pa

To further assess the effluent associated with offal cutting and washing, samples of wastewater were taken from offal preparation system and analysed for BOD, COD, NFR and TKN. The testing program was initially intended to cover three sites operating different techniques of material preparation. While some tests were undertaken, the results were far from conclusive. Restrictions were placed on sampling because of the costs of undertaking the sampling and laboratory analysis.

Due to cost constraints in investigating this opportunity, no definite conclusions could be drawn from these results and the opportunity was not pursued.

Blood Processing

Blood is collected from the slaughter floor and is transferred to a separate plant where it is dewatered and dried to produce a low moisture meal. The majority of the water removal is done using a centrifugal decanter. The raw blood is coagulated with steam, which is then spun at high speed to separate the solid and liquid phases. The liquid phase is drained while the solids are collected for further drying.

This wastewater had a high protein loading contributing to the overall organic loading of the wastewater. Preliminary investigations were conducted to look at:

- Coagulation techniques;
- Decanter settings; and
- Effect of moisture content on the thermal energy efficiency of the drier.

Based on measured flows, flow composition and temperature of various streams produced during the blood processing, a mass balance of the organic loading of the wastewater and the thermal energy consumed was developed. The results indicate that mechanical dewatering, by the centrifugal decanter, is about 20 times more energy efficient than thermal drying. Therefore if more liquid is removed in the centrifugal decanter, then less thermal drying will be required and overall energy consumption (and associated cost) is lower. The efficiency of the centrifugal decanter separation depends on the relationship between the depth of the liquid in the drum and the length of the exit-drying region (beach), with:

- Deep liquor in the decanter producing a low strength waste liquor but wet solids; and
- Shallow liquor in the decanter producing high strength waste liquor but dry solids.

Therefore, one cleaner opportunity identified was the optimisation between the centrifugal and thermal drying processes. In optimising this system downstream processing costs need to be considered, such as costs of treating the waste liquor from the centrifugal decanter in the wastewater treatment plant. Again, due to cost constraints in investigating this opportunity further, the optimisation of the blood drying process was not pursued.

Coal Boiler Performance

Coal fired boilers have traditionally been used to raise steam used to heat water and render waste material. The AMH group operated 5 coal-fired boilers, situated at the Aberdeen, Beaudesert, Dinmore, Guyra and Townsville sites. Assessment prior to the cleaner production initiative identified significant differences were found in the coal burning performance of the boilers and opportunities to significantly improve boiler performance.

Based on the advice of the consultant, it was expected that the improved boiler performance could be achieved with little or no capital costs and therefore the opportunity was pursued.

Cleaner Production Initiatives

Coal boiler performance

Before the commencement of the Project, as part of a previous AMH initiative, samples of coal and waste ash were taken from each site operating a coal fired boiler. These samples were all sent to Brisbane from where they were forwarded to the Australian Coal Institute Research Laboratory (ACIRL). The samples were tested for :

- Specific Energy (kJ/kg);
- Percentage Ash; and
- Percentage Moisture.

The results indicated that Aberdeen and Guyra sites had lower coal combustion efficiency than the boilers at Dinmore, Beaudesert and Townsville. This meant that energy was being wasted, resulting in higher steam and production costs.

The results indicated that between 2% to 29% of total fuel supply was not combusted in the coal boilers. The least efficient boiler generated an additional 230 kg of unburned materials per ton of coal. This unburned material was retained in the ash and required disposal to landfill.

The two poor performing boilers were targeted for detailed investigation. This investigation encompassed a number of steps including:

- Reviewing operating procedures;
- Reviewing steam load review; and
- Reviewing boiler controls.

The review identified that the boiler attendants had difficulty in operating boilers so as to meet steam demand. The attendants bypassed the automatic controls on each boiler and the boilers were run in manual. While this achieved the aim of ensuring consistent steam pressure from the boilers, it led to inefficient coal combustion.

Project Implementation

Through an in-house program, staff was trained in the practices of boiler energy efficiency and the correct management of the boilers. This meant that the boiler attendants could operate the boilers using the automatic control and meet the steam demand for the site. The training led to an immediate improvement in boiler performance with a decrease in the percent of uncombusted coal from 25% to 2% at Aberdeen and 13% to 4% at Guyra.

Environmental and Economic Benefits:

All of the five coal boilers are now consistently performing with an ash specific energy of 6kJ/kg or less. The ash specific energy is the energy per unit mass that would be released if the ash were burnt. At Aberdeen efficiency has improved from 70% to 98% and at Guyra from 87% to 96%.

Over a year this equates to a 27% and 9% decrease in coal usage in combustion, which is equivalent to 1000 tons per year of coal at Aberdeen and 290 tons per year at Guyra. The cumulative coal cost savings are anticipated to be $65,000 per year, which is 21% of the combined costs of coal at Guyra and Aberdeen.

The improved boiler operation also led to a decrease in ash disposed to landfill from these two sites by approximately 275 tons per year.

These successes are now being sustained by continued monitoring and performance of the boilers by AMH engineering support service personnel who provide monthly analysis and reporting together with expert technical assistance in the review of ash results. The cost of the monthly analysis per site is $3,000/yr.

Constraints:

Challenging aspects of the AMH Cleaner Production Project were:

- The Project was run on a "group" basis, rather than a site-by-site basis. As such, it was difficult to obtain site information and motivate site staff, when removed from the day-to-day operation of the abattoir; and
- The AMH representative responsible for "driving' the Project left the company during the course of the project, which subsequently lost momentum.

Operating pressures on the AMH group have restricted both the time and effort that were available for the Project. At the time of the Project, the company was restructuring at site level, which will probably result in the building of new facilities. The investigative work that has been done during this project will undoubtedly be of value in the design phase.

The cleaner production demonstration project at AMH illustrated a number of valuable lessons with respect to the implementation of cleaner production.

AMH tried a firmwide approach to cleaner production that attempted to identify opportunities that could be applied to all their sites. This approach is only successful when the individual sites can also have ownership of the opportunities, as it is inevitable site management will be asked to implement any initiatives and probably be made accountable for the success of the project.

The AMH project lost momentum when the cleaner production program coordinator left the organisation. While a coordinator is an important person in implementing cleaner production, it is important that the whole team has commitment to the project and that senior management continues to reinforce their commitment to the project.

The AMH Cleaner Production Project also demonstrated that an understanding of the environmental aspects of processes is critical in identifying potential opportunities. Appropriate monitoring is crucial in identifying assessing any opportunities.

Finally, AMH was restricted in implementing some of cleaner production opportunities due to the economic outlook of the meat industry. However, as demonstrated by the initiative which was completed, cleaner production does not necessarily have to involve the incurring of significant upfront costs. Through management control initiatives cleaner production can be integral in a firm's response to tough economic conditions.

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Review Status:

This case study was taken from The Cleaner Production Case Studies Directory EnviroNET Australia (see address above). It was edited for the ICPIC diskette in November 1998. It has not undergone a formal technical review by UNEP IE.

Subsequently, in March 1999 the case study underwent a technical review by Dr. Prasad Modak, Environmental Management Centre, Mumbai, India.