Meat Processing and Rendering

Industry Description and Practices

The meat processing and rendering industry includes the slaughter of animals and fowl, processing of the carcasses into cured, canned, and other meat products, and the rendering of inedible and discarded remains into useful by-products such as lards and oils. A wide range of processes is used. Table 1 provides information on water usage in the industry.

Waste Characteristics

The meat industry has the potential for generating large quantities of solid wastes and wastewater with a biochemical oxygen demand (BOD) of 600 milligrams per liter (mg/l). BOD can be as high as 8,000 mg/l, or 10–20 kilograms per metric ton (kg/t) of slaughtered animal; and suspended solids levels can be 800 mg/l and higher. In some cases, offensive odors may occur. The amounts of wastewater generated and the pollutant load depend on the kind of meat being processed. For example, the processing of gut has a significant impact on the quantity and quality (as measured by levels of BOD and of chemical oxygen demand, COD) of wastewater generated. The wastewater from a slaughterhouse can contain blood, manure, hair, fat, feathers, and bones. The wastewater may be at a high temperature and may contain organic material and nitrogen, as well as such pathogens as salmonella and shigella bacteria, parasite eggs, and amoebic cysts. Pesticide residues may be present from treatment of animals or their feed. Chloride levels from curing and pickling may be very high—up to 77,000 mg/l. Smoking operations can release toxic organics into air. Rendering is an evaporative process that produces a condensate stream with a foul odor.

All slaughtering wastes (generally, 35% of the animal weight) can be used as by-products or for rendering. The only significant solid waste going for disposal is the manure from animal transport and handling areas.

Table 1. Typical Water Usage in the Meat Industry

(cubic meters per metric ton of product)

Process	*Water use*
Slaughterhouse	
Pigs	1.5–10
Cattle	2.5–40
Poultry	6–30
Meat processing	2–60

Pollution Prevention and Control

Separation of product from wastes at each stage is essential for maximizing product recovery and reducing waste loads. The materials being handled are all putrescible; hence, cleanliness is essential. Water management should achieve the necessary cleanliness without waste. The amounts and strength of wastes can be reduced by good practices such as dry removal of solid wastes and installation of screens on wastewater collection channels.

In-plant measures that can be used to reduce the odor nuisance and the generation of solid and liquid wastes from the production processes include the following:

- Recover and process blood into useful by-products. Allow enough time for blood draining (at least seven minutes).
- Process paunches and intestines and utilize fat and slime.

- Minimize water consumed in production by, for example, using taps with automatic shutoff, using high water pressure, and improving the process layout.
- Eliminate wet transport (pumping) of wastes (for example, intestines and feathers) to minimize water consumption.
- Reduce the liquid waste load by preventing any solid wastes or concentrated liquids from entering the wastewater stream.
- Cover collection channels in the production area with grids to reduce the amount of solids entering the wastewater.
- Separate cooling water from process water and wastewaters, and recirculate cooling water.
- Implement dry precleaning of equipment and production areas prior to wet cleaning.
- Equip the outlets of wastewater channels with screens and fat traps to recover and reduce the concentration of coarse material and fat in the combined wastewater stream.
- Optimize the use of detergents and disinfectants in washing water.
- Remove manure (from the stockyard and from intestine processing) in solid form.
- Dispose of hair and bones to the rendering plants.
- Reduce air emissions from ham processing through some degree of air recirculation, after filtering.
- Isolate and ventilate all sources of odorous emissions. Oxidants such as nitrates can be added to wastes to reduce odor.

In *rendering plants*, odor is the most important air pollution issue. To reduce odor:

- Minimize the stock of raw material and store it in a cold, closed, well-ventilated place.
- Pasteurize the raw material before processing it in order to halt biological processes that generate odor.
- Install all equipment in closed spaces and operate under partial or total vacuum.
- Keep all working and storage areas clean.

Target Pollution Loads

Implementation of cleaner production processes and pollution prevention measures can provide both economic and environmental benefits. The production-related targets presented in Table 2 can be achieved by measures such as those described above. The numbers relate to the production processes before the addition of pollution control measures.

Table 2. Target Loads for Meat Processing and Rendering

Parameter	*Maximum level*
Water used	3–6 m^3/t of slaughtered animal
BOD	10–20 kg/t
Total nitrogen	100–200 mg/l
Total phosphorus	10–20 mg/l
Suspended solids	100–500 mg/l

Treatment Technologies

Wastewaters from meat processing are suitable for biological treatment and (except for the very odorous rendering wastewater) could be discharged to a municipal sewer system after flow equalization, if the capacity exists. Sewer authorities usually require pretreatment of the wastewater before it is discharged into the sewer.

Screens and fat traps are the minimum means of pretreatment in any system. Flotation, in some cases aided by chemical addition, may also be carried out to remove suspended solids and emulsified fats, which can be returned to the rendering plant. The choice of an appropriate biological treatment system will be influenced by a number of factors, including wastewater load and the need to minimize odors. Rendering wastewater typically has a very high organic and nitrogen load. Extended aeration is an effective form of treatment, but care must be taken to minimize odors.

Disinfection of the final effluent may be required if high levels of bacteria are detected. Ponding is a simple solution but requires considerable space. Chemical methods, usually based on chlorine compounds, are an alternative.

Biofilters, carbon filters, and scrubbers are used to control odors and air emissions from several processes, including ham processing and rendering. Recycling exhaust gases from smoking may be feasible in cases where operations are not

carried out manually and smoke inhalation by workers is not of concern.

Emissions Guidelines

Emissions levels for the design and operation of each project must be established through the environmental assessment (EA) process on the basis of country legislation and the *Pollution Prevention and Abatement Handbook*, as applied to local conditions. The emissions levels selected must be justified in the EA and acceptable to the World Bank Group.

The guidelines given below present emissions levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance. Any deviations from these levels must be described in the World Bank Group project documentation. The emissions levels given here can be consistently achieved by well-designed, well-operated, and well-maintained pollution control systems.

The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable.

All of the maximum levels should be achieved at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Air Emissions

Odor controls should be implemented, where necessary, to minimize odor impacts on nearby residents. Particulate matter emissions of smokehouses should be kept below 150 milligrams per normal cubic meter (mg / Nm^3), with a carbon content of less than 50 mg / Nm^3.

Liquid Effluents

The liquid effluent levels presented in Table 3 should be achieved.

Table 3. Effluents from Meat Processing and Rendering Industry

(milligrams per liter, except for pH and bacteria)

Parameter	*Maximum value*
pH	6–9
BOD	50
COD	250
TSS	50
Oil and grease	10
Nitrogen (total)	10
Total phosphorus	5
Coliform bacteria	400 MPN/100 ml

Note: Effluent requirements are for direct discharge to surface waters. MPN, most probable number.

Ambient Noise

Noise abatement measures should achieve either the levels given below or a maximum increase in background levels of 3 decibels (measured on the A scale) [dB(A)]. Measurements are to be taken at noise receptors located outside the project property boundary.

	Maximum allowable log equivalent (hourly measurements), in dB(A)	
Receptor	*Day (07:00–22:00)*	*Night (22:00–07:00)*
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Monitoring and Reporting

Monitoring of the final effluent for the parameters listed in this document should be carried out at least once a month—more frequently. if the flows vary significantly. Effluents should be analyzed for pesticides annually; if pesticides are present above 0.05 mg / l, appropriate corrective actions should be taken. Records of monitoring results should be kept in an acceptable format. The records should be reported to the responsible authorities and relevant parties, as required.

Key Issues

The key production and control practices that will lead to compliance with emissions guidelines may be summarized as follows:

- Design and operate the production systems to achieve target water consumption levels.
- Separate cooling water from process water.
- Dry-clean production areas before washing, and provide grids and fat traps on collection channels.
- Eliminate wet transport of waste.
- Recover blood and other materials and process into useful by-products.
- Send organic material to the rendering plant.
- Design and operate the rendering plant to minimize odor generation.

Sources

Economopoulos, Alexander P. 1993. *Assessment of Sources of Air, Water, and Land Pollution: A Guide to Rapid Source Inventory Techniques and their Use in Formulating Environmental Control Strategies.* Part 1: *Rapid Inventory Techniques in Environmental Pollution.* Geneva: World Health Organization.

World Bank. 1996. "Pollution Prevention and Abatement: Meat Processing and Rendering." Draft Technical Background Document. Environment Department, Washington, D.C.