

Meat Processing and Rendering

Industry Description and Practices

This industry includes the slaughtering of animals and fowl, processing of the carcasses into meat products (cured, canned, etc.), and the rendering of inedible and discarded remains into useful by-products such as lards and oils. A wide range of processes are used. The table below presents water usage in the industry:

Typical Water Usage in the Meat Industry

Process	Water use cubic meters per metric ton ((m ³ /t) product)
Slaughterhouse	
Pigs	1.5 - 10
Cattle	2.5 - 40
Poultry	6 - 30
Meat processing	2 - 60

Waste Characteristics

The meat industry has the potential for generating large quantities of solid waste and waste waters with a biochemical oxygen demand (BOD₅) level of 600 milligrams per liter (mg/L) (this can also be as high as 8,000 mg/L) or 10 to 20 kilograms per metric ton (kg/t) of slaughtered animal and suspended solids level of 800 mg/l and higher, as well as, in some cases, offensive odors. The amounts of wastewater generated and pollutant load depend on the kind of meat being manufactured. For example, the processing of gut has a major impact on the quantity and quality (BOD and chemical oxygen demand

(COD) levels) of wastewater generated. The wastewater from a slaughterhouse can contain blood, manure, hair, fat, feathers, and bones. The wastewater may have a high temperature, and may contain organic material and nitrogen content. It may contain pathogens, including Salmonella and Shigella bacteria, parasite eggs, and amoebic cysts. Pesticide residues may be present from treatment of animals or their feed. Chloride levels may be very high (up to 77,000 mg/L) from curing and pickling processes. 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.

Pollution Prevention and Control

Separation of product from wastes at each stage is essential to maximize product recovery and reduce waste loads. The materials being handled are all putrescible; **hence, cleanliness is important.** 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 waste and providing screens on wastewater collection channels.

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

- 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 the production processes, for example, by the use of taps with automatic shut-off, the use of high water pressure and improvement of the process lay-out.
 - Eliminate wet transport (pumping) of wastes (for example, intestines and feathers) to minimize water consumption.
 - Reduce the liquid waste load by preventing all solid wastes and all concentrated liquids from entering the wastewater stream.
 - Cover collection channels in the production area with grids to reduce the amount of solids entering wastewater.
 - Separate cooling waters from process and waste waters 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 with 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.
- Odor reduction is the most important air pollution issue in rendering plants and can be achieved by:
- Minimizing the stock of raw material and storing it in a cold, closed, well-ventilated place.
 - Pasteurizing the raw material before processing it in order to halt biological processes that generate odor.
 - Installing all equipment in closed spaces and operating under partial or total vacuum.
 - Keeping 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 following production-related targets can be achieved by measures such as those detailed in the previous section. The numbers relate to the production processes *before* the addition of pollution control measures.

Target Loads

<i>Parameter</i>	<i>Maximum Level</i>
Water used	3 to 6 m ³ /t of slaughtered animal
BOD ₅	10 to 20 kg/t
Total nitrogen	100 to 200 mg/L
Total phosphorous	10 to 20 mg/L
Suspended solids	100 to 500 mg/L

Treatment Technologies

The waste waters are suitable for biological treatment and (except for the very odor rendering wastewater) could be discharged to a municipal sewer system after flow equalization if the capacity exists. Sewage authorities usually require pretreatment of the wastewater before its discharge into the sewer.

Screens and fat traps are the minimum level of pretreatment in any system. Flotation (in some cases aided by chemical addition) may also be provided 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 and 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. Recycle of 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.

Emission Guidelines

Emission levels for the design and operation of each project must be established through the Environmental Assessment (EA) process, based on country legislation and the *Pollution Prevention and Abatement Handbook* as applied to local conditions. The emission levels selected must be justified in the EA and acceptable to MIGA.

The following guidelines present emission levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance, including MIGA guarantees; any deviations from these levels must be described in the project documentation.

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 smoke houses should be kept below 150 milligrams per normal cubic meter (mg/Nm^3) with a carbon content of less than $50 \text{ mg}/\text{Nm}^3$.

Liquid Effluents

The following liquid effluents should be achieved:

Effluents from Meat Processing and Rendering Industry

<i>Parameter</i>	<i>Maximum value milligrams per liter (mg/L)</i>
pH	6 - 9
BOD ₅	50
COD	250
Total suspended solids	50
Oil and grease	10
Nitrogen (total)	10
Total Phosphorus	5
Coliform bacteria	400 Most Probable Number/100 milliliters (mL)

Note: Effluent requirements are for direct discharge to surface waters.

Ambient Noise

Noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

Ambient Noise

Receptor	Maximum Allowable L_{eq} (hourly), in dB(A)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The emission requirements given here can be consistently achieved by well-designed, well-operated and well-maintained pollution control systems.

Monitoring and Reporting

Monitoring of the final effluent for the parameters listed above should be carried out at least once per month, or more frequently if the flows vary significantly. Effluents should be analyzed for pesticides annually, and if pesticides are present above 0.05 mg/L, appropriate corrective actions taken. Records of monitoring results should be kept in an acceptable format. These should be reported to the responsible authorities and relevant parties, as required, and provided to MIGA if requested.

Key Issues

The following box summarizes the key production and control practices that will lead to compliance with emissions guidelines:

- 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 to collection channels.
- Eliminate wet transportation of waste.
- Recover and process blood and other material into useful by-products.
- Send organic material to the rendering plant.
- Design and operate the rendering plant to minimize odor generation.

Further Information

The following are suggested as sources of additional information (these sources are provided for guidance and are not intended to be comprehensive):

Economopoulos, A.P. 1993. "Rapid Inventory Techniques in Environmental Pollution." In *Assessment of Sources of Air, Water and Land Pollution*. Geneva: World Health Organization.

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