Pollution from Meat Processing Factories

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Abstract

A basic understanding of the nature of meat plant wastewaters and factors that influence these wastewaters is essential for the control of wastewater volume and waste loads. Analyzing waste characteristics of the meatpacking industry is not a simple matter. It is difficult to characterize a “typical” plant and its associated wastes, owing to the many procedures and facets of meat-processing operations. However, some similarities have emerged during extensive study and research.

Key words: Meat industry, wastewater, solid waste, waste gas stream

Introduction

Key resources used by the meat processing industry include: water, raw materials and energy. The meat processing industry uses large quantities of water. Water is used as an component of final products, an initial and intermediate cleaning source, an efficient transportation conveyor of raw materials, and the principal agent used in cleaning of plant machinery and areas. Although water use will always be a part of the meat processing industry, it has become the principal target for pollution prevention. The quantity of processing wastewater and its general quality, are both economic and environmental factors in the treatability and disposal of wastewater [1].

The waste load from a meat processing plant is a result of blood, flesh particles, soluble proteins and waste materials which are intentionally or inadvertently released to the sewer system. There are three proven ways to reduce waste load as well as water use and wastewater discharge. First is to operate the plant more efficiently. Second is to make process modifications to reduce water use and waste, and third is to consider pretreatment steps to reduce the waste load.

Water, sewer and overload costs are significant to any meat plant. Well-trained employees, modern technology and management support are necessary to achieve cost reduction through reduced use of water and generating fewer amounts of waste.

Water is a basic and necessary tool for the meat industry. In meat processing and quality control, water helps to cleanse the product and remove unwanted materials. But in wastewater handling, water flushes organic and inorganic matter to the sewer. Wastewater treatment is basically a processing system to separate the organic and inorganic matter from the water that collected it. Thus, keeping organic and inorganic matter out of the water eliminates the necessity for treatment. The goal of every wastewater engineer is to remove organic solids without discharging them to the sewer, and to use an absolute minimum of water for the essentials of sanitation.

Meat processing wastewaters

The meat industry is a branch of the food industry, which causes degradation of the environment to a large extent. The wastewater produced in it contains a variety of organic and inorganic pollutants, has a high concentration of etheric extract, suspended and biogenic matter as well as variable concentrations. A basic understanding of the nature of meat plant wastewaters and factors that influence these wastewaters is essential for the control of wastewater volume and waste loads.

Typical slaughterhouse and packing house wastes are generally high in 5-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total suspended solids (TSS), floatable material and grease (FOG). The amounts of wastewater generated and pollutant load depend on the kind of meat being manufactured.

Chemical oxygen demand (COD) and biochemical oxygen demand (BOD_5) are common measurements used to determine water quality. They measure the strength of the waste stream by measuring the oxygen required to stabilize the wastes. COD and BOD_5 are important to the meat processing industry because they can be used to indicate lost product and wasteful practices. High BOD_5 and COD levels indicate increased amounts of product lost to the waste stream. Measurements at various process locations can help locate sources of waste. [2]

The waste is usually at an elevated temperature and may contain organic material: blood, bits of flesh, fat, manure, dirt and viscera. 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. Chlorides, phosphorus and nitrogen compounds are also found in the waste load. Chloride levels may be very high (up to 77,000 mg/L) from curing and pickling processes.

Separation of product from wastes at each stage is essential to maximize product recovery and reduce waste loads. The materials being handled are all susceptible to decay. hence, cleanliness is very 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 [3].

The principal operations and processes in meatpacking plants where wastewater originates are:

- Animal holding pens
- Slaughtering
- Cutting
- Meat processing
- Secondary manufacturing (by-product operations)
- Cleanup operations

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 byproducts [4,5]. Allow enough time for blood draining. By reducing the volume of blood lost to the effluent stream by only 100L each day, a meat plant disposing of its effluent by land application could reduce the land area required by 2.5 ha. This blood, if recovered for blood processing, also represents a gain in product revenue. Blood recovery, grease recovery, separate paunch manure handling and efficient rendering operations can reduce waste loads substantially and may also produce salable by-products.

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.

Reduce the liquid waste load by preventing all solid wastes and all concentrated liquids from entering the wastewater stream by covering 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 pre cleaning of equipment and production areas prior to wet cleaning. Dry cleaning methods should be used to collect the solids as close to source as possible this maximizes recovery for rendering. Dry cleaning before hosing down the floor will reduce the amount of water used for 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.
For meat plants that do not carry out on-site rendering, blood processing or other major by product processing operations, it is estimated that the feces and gut contents would typically account for more than 75% of the phosphorous and 50% of the nitrogen, sodium and organic loading in primary screened or settled effluent from the plant.
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. Pasteurization 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.

Treatment Technologies

Choice of technology for treatment of waste water is not an easy and irresponsible task. Industrial wastewater components show different degrees of environmental nuisance and contamination hazard due to their chemical characteristics as well as excessive concentration. Therefore, the treatment of wastewater, which is particularly hazardous to the environment, requires a number of complementary techniques that sufficiently remove pollutants and enable the wastewater to be discharged into receiving water or be reused for industrial purposes. Abattoirs and the meat processing industry use a huge amount of water. The whole chain from cattle delivery, slaughtering and processing to the final cleaning is subject to strict hygiene regulations. That is why large amounts of wastewater accrue that is highly polluted with organic substances- containing blood and dissolved proteins, fat, straw, sawdust and residues of animal excrements. Since the wastewater contains substantial amounts of proteins, it putrefies easily and gives off nasty smells. Especially if this wastewater cannot be disposed fast and reliably, germs and insect attacks, threatens the plant.
The wastewaters of meat processing industry 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. Especially abattoirs have to deal with unpleasant smells due to the accrual of ammonia and hydrogen sulphide as well as the accumulation of solids from deposition. Oftentimes this leads to complaints from residents and the formation of action groups targeting the companies. Sewage authorities usually require pretreatment of the wastewater before its discharge into the sewer. Mechanical pre-cleaning is very important, particularly for municipal wastewater, in order to ensure the efficient functioning of the wastewater technology in the following treatment steps. The pre-cleaning will prevent blockages and damages and thus unnecessary maintenance schedules and superfluous cost. Screens and fat traps are the minimum level of pretreatment in any system.
If the wastewater contains water-insoluble substances or colloids, for instance, sedimentation, filtration or centrifugal separation becomes necessary to achieve efficient wastewater treatment. 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 maybe feasible in cases where operations are not carried out manually and smoke inhalation by workers is not of concern.

Conclusion

Production of wastes during the processing of meat products is not desirable because it significantly deteriorates the quality of the final product as well as causes some serious health threats if not properly disposed-off. The majority of the waste, in the meat industry is produced during slaughtering. The composition of waste generated by the meat industry depends on species of animals slaughtered. The waste material of the meat processing industry contains plentiful amount of organic compounds due to which its disposal is quite difficult. Efficient utilization of by-products has direct impact on the economy and reduce environmental pollution.
Meat by-products have been used all over the world since decades but due to certain health concerns there is need to develop new technologies for safe processing and efficient utilization. This is also very important to develop meat by-products with maximum cost-benefit ratio in the future for the viability of meat industry. Additionally, more research is needed to develop some innovative methods for the treatment of meat industry wastes. Moreover, modern extraction methods such as solvent extraction, microfiltration, solid phase extraction and super critical fluid extraction should be applied to extract several bioactive compounds from the effluents of the meat processing industries.
Wastewater from the meat industry is very difficult to purify due to its specific characteristics, irregular scatter, and considerable amounts of organic, mineral and biogenic matter. It can also be satisfactorily treated so that it can be reused in the production cycle of a plant. In addition to wastewater management, this study promotes good practice in the management of gas and solid waste stream in meat processing industry. This system has considerable advantages in terms of environmental protection, power savings and cost-effectiveness.

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