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Mini-review

ENVIRONMENTAL PROTECTION IN MEAT INDUSTRY

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ABSTRACT: In the meat industry the by-products make up to 70 percent of the slaughtered animal weight, and their utilization and safe disposal are regarded as a priority with respect to the ecological risk and the influence on the environment. Meat industry with its location in the suburban towns and villages is often a source of bad smell. Rodent and insect colonies on those sites are the source of infection and a high danger to human health.
In this paper, it was pointed out that contamination of the environment, especially of air and water, can have their origin in the process of removal of dead animals, inedible by-products, and during processing into feed or raw materials for chemical industry. It was emphasized that objects for animal wastes processing should be considered: as processing plants serving for the environmental protection but as possible environment polluters. The significance of safe disposal of animal wastes was analyzed from the view of environment protection, according to the rules of European Union, based on contemporary knowledge of science.

Keywords: *meat industry, polluters, environmental protection, animal wastes*

INTRODUCTION

Nowday lot of attention has been paid to the protection and improvement of human environment, since there is a constant increase in accumulation of waste materials. The country strives to produce highest possible quantities of productsto satisfy human needs for the best possible standard of living and to create optimal conditions for maintaining of sanitary conditions.

Nevertheless, together with welfare necessary to humans being, modern technical civilization creates high quantities of waste, which exert negative effects on the environment, degrading it to such degree that it becomes harmful for health of people and animals (13;8). Polluters are numerous, inorganic and organic substances that enter into an organism with contaminated air, water and food. Their quantities are small, but in the course of time, they accumulate in tissues and organs, causing diseases, degeneration or even death.

This is fully applicable on agricultural and cattle growing production,. Such one tendency is enabled with industrial production of feed and with even higher automation and mechanization in cattle growing (7). With the strengthening of production process in cattle growing and production of higher quantities of meat, emerges the problem of dead animals as well as of accumulation of slaughterhouse wastes (14). Dead animals and inedible slaughterhouse by-products, as waste material created in the production process, must be disposed safely, or, otherwise, they can become a serious tisk for further development of food production and they are serious polluters of the environment. They can contaminate

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the environment so everely,that it can hinder intellectual and operative capabilities of human and disable the possibilities for their recreation (17).

Animal wastes and inedible by-products during purification contaminate not only the atmosphere with bad smell and toxic gases, but also the territory, food and water. Ristić (13) quoted that the greatest part of blood end up in sewage, i.e. in waste water, and that only small part of blood is collected and processed. At the same time, blood appears as a nutrient for microorganisms, many of which strains are pathogenic for humans and animals. Biological oxygen demand of blood, according to Baras et al. (1), is about 100,000 mg O_2/L. In 1982, contamination of water streams with waste blood in than SFR of Yugoslavia was about $57 \cdot 10^9$, what corresponds to the pollution caused by about 1 million of inhabitants.

Pollution of the environment with animal wastes shows also other adverse effects. It is known that sites where accumulation of organic materials and their degradationare located, are places with ideal conditions for development of insects and rodents. They enable spreading of infections and substantially contribute to degradation of visual appearance of the environment. Inadequate handling of dead animals and by-products of farms and slaughterhouses also leads to contamination of soils, surface and underground water, food and different objects, making them inconvenient or less valuable for use (8;15).

The environment, especially air and water, can be contaminated even in the process of safe disposal of dead animals and of inedible by-products of slaughtered animals and their processing into feed and raw materials for chemical industry. Because of that “factory for animal wastes processing“should be considered from two points of view – as objects serving for environment protection, i.e. as manufacturing plants and, at the same time, as the environment polluters.

Polluters in the process of safe disposal of by products are:

- scattered inlet raw materials,
- waste waters,
- waste gases,
- organic dust, and
- contaminated solids not adequate for processing

Regarding the fact that objects for animal wastes processing has two basic functions – to protect the environment from pollution with animal wastes and to generate sanitary safe products, it is needed to implement regular measures for protection of the environment, during the designing of the object and during its regular operation, as well as during the unwanted incidents,. The protection primarily implies safe disposal of polluters that are generated in objects for animal wastes processing (13).

Disrespecting of the rules about safe disposal of polluters reflects on soil-, atmosphere-, surface- and underground water quality in nature, and thus on climate, plant and animals on human health and finally on the ecosystem as the whole.

Waste waters from the meat processing industry

Slaughterhouse industry is a great consumer of bacteriologically and physico-chemically correct water; it is believed that for each slaughtered cow or swine some 500 to 1,000 liters of water are used. With regard to water used in slaughter house industry, we have to make distinction between technological water and water for sanitary purposes that must have drinking water quality(2).

- Process water should fulfill requirements of the WHO for drinking water,
- Sewage systems and waste disposal systems should be designed and constructed in a manner whereby the risks of contamination of the processed water is avoided.

Water that comes in immediate contact with manufacturing stream has to be of exclusive of sanitary quality. Ice and steam also must not represent a risk to health and safety of food.

The largest part of water consumed in slaughter-houses appears in the technological waste effluents. For effluent disposal, all areas have to possess the co-

rresponding numbers of gutters or wa-ter drains. Gutters must have efficient system of prevention for returning of unpleasant odors from the sewage.

Waters contain plentiful quantities of organics, chlorine and residues of substances used for cleaning and sanitation (biological oxygen consumption- BOD5=200-1500 mg O2/l; chemical consumption oxigen- COD=800-1700 mg O2/l) (3).

Therefore, waste waters from slaughter houses should, prior to being disposed into some natural depot or local sewage system, pass through pretreatment and/or biological treatment. Pretreatment of waste water includes fat removal, sedimentation of suspended particles and chlorination.

Sewage systems for atmospheric and sanitary waste waters are united with the technological waste water systems only after the equipment for their pretreatment (BOD 5<300 mg O2/l: COD<450 mg O2/l) (16).

Preventive measures

During designing of the environmental protective system the following has to be established:

- what effect the organization has on the environment;
- which legal and other claims are submitted to the organization with respect to the environment protection;
- what task the organisation sets itself with respect to the environment protection;
- which activities are going to be performed with respect to the environment protection, within what time periods, and who is going to be responsible for them.

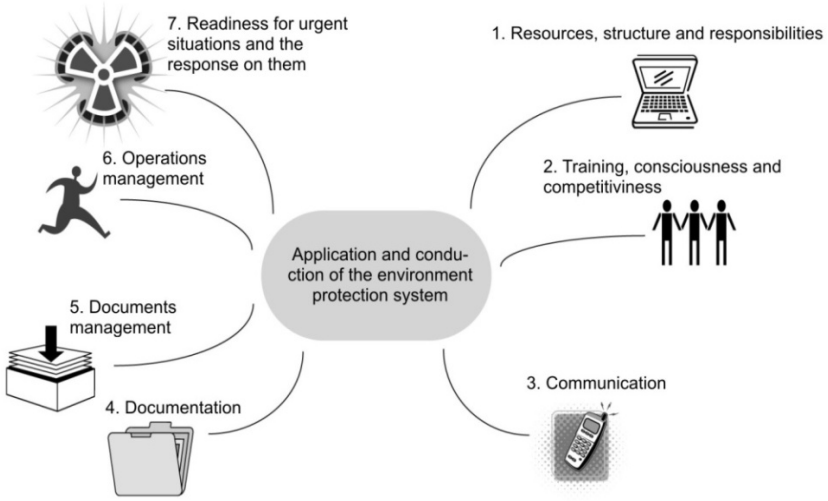

Figure 1. Requirements of the ISO 14001 with respect to conducting of the systems for environment protection (16)

The designing starts with identification of products, processes or activities that have an influence on the environment and determining what the nature of that in-fluence is. Attention is given to the aspects that the organization can control itself. After that, from the whole list of identified aspects, those that significantly influence the environment are selected, so that they could be effected.

Generally, even if the organization performs only one activity, effects on the environment could be numerous, for example:

- disposal of harmful substances in water, air or on the soil;
- depletion of non-renewable energy resources;

- creation of noise, vibrations or unpleasant odors;
- creation of smoke and dust;
- electromagnetic and other radiations;
- heaping up of industrial and communal wastes;
- consumption of natural resources;
- detrimental effects on plants and animals as well as threats to rare and protected species.

General requirements for designing, construction and maintenance of a system for protection of the environment are shown in Figure 1.

The majority of these requirements are similar or identical to those stated in the ISO 9001 norm. Identification of aspects and effects of meat industry on the environment are shown Table 1.

Table 1.
Identification of aspects and effects of meat processing on the environment industry

Activity	Aspect	Effect
Receiving of animals	Emissions of gasses and unpleasant odors, water with mechanical impurities, feces and urine, dead animals	
Bleeding line	Water with blood	
Scalding	Warm water with impurities from carcasses and blood traces	
Hair and hoof removal	Hair, warm water, impurities from carcasses, hoof	
Burning of carcasses	Water with the burned epidermis	
Final rinsing	Water with burned epidermis, hair residues	
Eyes and outer ear channels removal	Extracted organs for the pound	Water contamination
Removal of organs of intestinal and lung cavities, veterinary inspection of organs	By-products for the pound, water containing blood and fats	Air contamination
Cutting of carcasses	Water containing blood and bone sawdust	Soil contamination
Inspection of halves	Separation of the infected carcasses	
Final rinsing of the halves	Water containing blood and bones sawdust, parts of the internal organs, fats	
Sterilization of instruments, final cleaning of the line of slaughtering, disinfection	Warm water containing blood, fat and tissue residues, mechanical impurities, water solution of disinfectants	

- During evaluation of the significance of those effects, the following needs to be observed:
- probability of appearance (e.g., often, seldom, never);
- duration (e.g., for a very short time, average, long time);
- level of the action (e.g., action limited to the locus of origin, action zone attacks the whole city region, action is observable in the whole region);
- intensity of the effect (e.g., without influence, small consequences, big consequences, catastrophic consequences).

It is necessary to define politics, goals, tasks, repositories of the implications and terms.

Policy:

Process should be conducted in such a way which is suitable for reduction or full prevention of every kind of emission into air and water during the processing phases, by

using manuals and conducting of the good manufacturing practice (GMPs).

Goals:

1. Reduction of waste water quantities;
2. Reduction of risks of emission in the atmosphere and in water;
3. Reduction of pollution of waste water with solid particles;
4. Increased usage of slaughterhouse by-products;
5. Increased efficiency of primary settling tank – decanter, with the use of the selected commercial preparations.

Waste water of slaughterhouse is composed of:

- Composite waste water created by joining of a number of waste water streams from different processing plants, laboratory and sanitary net. Composite waste water is collected in the collecting unit, from which it should be conducted into system of the waste water treatment.
- Atmospheric waste water, which should be collected in the open channels aimed for irrigation outside of the factory.

Requirements with respect to the quality parameters of composite waste water – effluent are defined by a Manual about quality of waste water that could be introduced into official sewage system on the level of community where the given object is upraised. Waste water must be disposed from three separate sewage systems: atmospheric sewage, sewage for waste water originating from production plants and fecal sewage.

The greatest part of slaughter house waste water consists of waste water from production plants, which contain elements of animal tissues, fat, protein, salt and materials used for cleaning and disinfection. Pretreatment of that waste water includes: filtering, rough settling, fat separation and disinfection. After pretreatment, the solid part is transported to the pound, and the liquid is introduced into the composite waste water collecting system. The quantities of organic wastes are enormous according to the examination of the morphological composition of wastes which the community enterprises in Serbia collect. Organics make up to 60–75 percent of total waste collected in Serbia which is disposed on dumps (5) .

Waste water analyses in processing plants are performed for technological complexes (water and solid residues) before and after the pretreatment unit.

Sampling and analyzing of the composite waste water is performed quarterly, according to current Regulations regarding minimal number of examinations of waste water quality (10), by an accredited external laboratory. Regular periodic examinations in accordance with the design of control and investigation, as well as the emergency examinations, are performed in the plant-owned laboratory.

Waste water treatment processes within the plant are performed by:

- neutralization of waste water and mechanical separation of solid materials on grids, and
- separation of oils and fat in the primary cleaning unit – decanter (pool with several chambers with introduction of water from the top or bottom).

Organic content of the composite waste water varies very much, from several mg/dm^3 up to several tenths of g/dm^3, depending on the ongoing manufacturing process and on accidental situations. Temperature, as well as total quantity of water that is disposed daily and are also variable. Based on the periodically performed measurements, composition of the waste water influent in decanter can be estimated, and corresponding biode-gradable chemicals for water treatment can be selected.

Decanter contents are periodically emptied and transported into pound plants.

Besides the basic water parameters (temperature, pH, dry residue, suspended solids, ammonia, total nitrogen, hydrogen sulphide, total phosphorus, biological oxygen consumption-BOD5, chemical consumption oxigen, dissolved oxygen, alkalinity, total organic substances, total number of mesophyllic microorganisms: *Sulphate-reducing clostridia, Coliform bacteria, Escherichia coli, Proteus*),

cleaning agents, examines the pre-sence of: detergents, grease and oil.

With respect to water consumption in the food industry as a whole, as well as in the meat industry, there is an opinion that high consumption provides good sanitary conditions, while another point of view is that rational consumption will not threaten hygienic conditions. These two approaches can be reconciled only with technological discipline and rational behavior. Another possibility is the introduction of definite recirculation circles, such as in sugar industry. Nevertheless, the greatest possibilities and savings are found in the technology of manufacturing, and the most significant among them are: dry collection of solid wastes by using jet system under pressure, separation of all atmospheric and industrial sewage systems, application of a slaughtering system that enables collection of maximal quantities of blood, incorporation of more fat collectors in the production streams, grids, usage of modern bio-de-gradable cleaning agents, maximal utilization of slaughterhouse by-products and of other biotechnologies. This represents a contemporary ecological approach to sustainable development, where a product has to be traced from the design phase up to its consumption (e.g. from farm to fork, and even further, to the disposal of food residues as communal wastes). Our country is, through the corresponding legislative regulations, approaching conditions in the EU, and for all subjects in the economy it is obligatory to introduce rigorous control systems and GMPs, in order to minimize pollution and to enable waste treatment prior to introduction of waste water into recipient and application of the legally permitted limits.

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