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Review paper

APPLICATION OF BEST AVAILABLE TECHNIQUES FOR ENVIRONMENTAL PREVENTION IN MEAT PROCESSING

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ABSTRACT: The principle of BAT (Best Available Techniques) as a set of technical measures and procedures, together with its way of application is being introduced more and more into industrial practice. In the European Union BAT implementation is defined with Industrial Pollution Prevention and Control Directive (EC 2008/01) which combines preventive and reactive approach to industrial pollution. By issuing the Environmental Law Republic of Srpska has also introduced BAT principle as most effective and advanced level of industrial activity and its production and maintaining procedures, available for the operator, which can be used for determination of limit emissions for the purpose of prevention and reduction of environmental impact. By application of BAT high level of environmental protection is achieved, which is reflected in lower energy and raw materials consumption and reduction of environmental emissions. This paper presents industrial procedures for meat processing. Referent specific environmental performance indicators for fresh water consumption, energy consumption and waste water composition and quantities are also given.

Key words: *best available techniques, meat processing, IPPC directive*

INTRODUCTION

One of the biggest news is the adoption of the strategic principles of the IPPC Directive (Integrated Pollution Prevention and Control, 2008), which speaking on integrated pollution prevention and control, arising from the work of a particular Industrial plant. The aim of the Directive on Integrated Pollution Prevention and Control is to prevent pollution, or if not possible, to reduce to a minimum:

1. the emission of pollutants into the air, water or land and,
2. disposal of waste and other negative environmental impacts caused by industrial plants, so that their actions were consistent with a high level of environmental protection in general.

For operation of industrial facilities is necessary to obtain a permit that includes a complete study of the environment for each of them, and must be based on best available techniques (BAT Best Available Techniques), in various industrial sectors. This means that business operators need to install the specified date technological solutions, which are today the most modern and guarantee the lowest emission levels in the environment (Nježić end Okanović, 2010; Mastilović et al., 2010; Đukić et al., 2011).

Access to EU member states in implementing the IPPC directive is different. Some countries, like Great Britain, tried to consistently apply the provisions of the Directive, while others, such as Denmark or Sweden, it was assumed that the IPPC requires only small changes in the current way of doing business, and that, as long as the good quality of the environment, their current philosophy and practice of environmental permitting can be considered adequate. Greece has decided to implement the IPPC Directive through the existing system of environmental permitting. In the current Greek law, permits are required for all types of industries,

although requirements vary with the potential to produce pollution. The basis for issuing environmental permits, the Law on Environmental Protection.

In Appendix 1 IPPC (2008) is a list of industrial activities to which it relates. Limit meat processing capacity is 75 t / day.

The overall strategy of the IPPC Directive can be represented graphically in Figure1. (MOED, 2000).

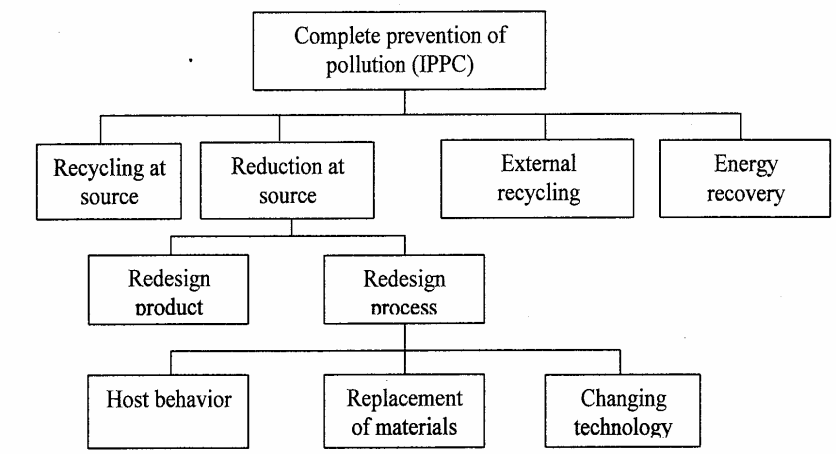

Figure 1. The strategy of the IPPC Directive

UNIT OPERATIONS IN MEAT PROCESSING

In meat processing are present in the following technological operations: (IPPC, 2008; Okanović et al., 2009)

- wash raw materials,
- thawing,
- fragmentation (cutting, grinding, chopping),
- mixing,
- salting,
- designing,
- drying,
- cooking/baking,
- pasteurization / sterilization,
- cooling
- packaging,
- cleaning and disinfection of processing equipment.

IMPACT ON THE ENVIRONMENT OF MEAT PROCESSING

Environmental impact is reflected in the consumption of fresh water, waste water discharge, energy consumption and waste generation. The presented quantified data relating to the production of certain types of meat products.

Water consumption

The greatest impact on the environment in meat processing wastewaters have. In meat processing, according to the literature data of water consumption ranges from 20–20 m^3/t, and the amount of waste water 10–25 m^3/t of processed meat (World Bank Group, 1998). The quantities of water consumed varies depending on the particular types of meat products. The largest use of water for washing and defrosting meat (3–5 m^3/t). Other phases in the processing of meat that require expenditure of significant amounts of water are: pasteurization, sterilization, cooling, cleaning and disinfection. Strict hygiene measures employed in cutting and crushing / grinding meat cause the formation of large amounts of waste water from cleaning of process equipment and work surfaces.

Consumption of water, waste water load and type of solid waste in the production of salami and sausage

The production of salami and sausages greatest impact on the environment have the smoking process. Smoke created by burning wood and sawdust contain com-

ponents harmful to human health: phenols, nitrite, N – nitrosated compounds, polyaromatic hydrocarbons and CO. Research in Norway measured the level of air pollution caused by smoke from the kiln. 1t drying the finished product is emitted 0.3 kg CO, 0.15 kg of inorganic particles and 0.2 kg of total organic carbon. Soot and tar compounds deposited on the chamber walls the smoking Peru is a strong alkaline funds from which follows a large consumption of water and high organic load of wastewater. In Table 1 shows the specific consumption of water and waste water load in the production of salami and sausages (Nordic Council of Ministers, 2001).

Table 1.
Specific water consumption and waste water load in the production of salami and sausages

Parameter	Production of salami	Production of sausage
Water consumption, m^3/t	7,5	10
BPK_5 in wastewater, kg/t	4,7	8-10
N in wastewater, g/l	300	no data
P in wastewater, g/l	140	no data

Table 2.
The quantities of solid waste in the processing of different kinds of meat

Solid waste	The quantity of waste in cutting and separation of bone (% of the quantity of fresh meat)		
	Beef	Pork	Poultry
Bone	12	5-9.5	1-2
Fat	12	3-6	6
Skin			1-2

The Italian companies for the production of salami and ham water consumption to 10-20 m^3/t of finished product; biological wastewater load ranges 20–25 kg/t and the quantity of solid waste is 30–50 kg/t (Nježić and Okanović, 2009).

Emissions to air

The main air emissions from meat processing plants coming from the boiler (steam) and the smoking chamber. Due to the failure refrigeration can cause cooling of air pollution emissions, but these are extraordinary cases.

Power consumption

Significant amounts of thermal energy are spent in cooking, pasteurization, sterilization, and smoked meat. Other operations that require power consumption are: cooling, freezing and cleaning.

Solid waste

Skin created by cutting meat, bones and fat. The bones and fat are used for the production of adhesives, detergents, and gelatine. Ratio quantities of fresh meat entering the processing (skinning, bone separation and fat) and waste materials is shown in Table 2 (Awarenet, 2002; Ristić et al, 2008).

WASTEWATER MEAT PROCESSING

Due to various technological operations in the processing of meat and the lag in the work, the composition of waste water are not uniform. The following text describes the characteristics of water in certain technological meat processing operations.

Waste water from brining/salting meat

The effluent from the brining/salting of meat there is a high concentration of NaCl

and $NaNO_3$. In case of wet brining must take into account the amount of baths to be prepared for curing, because at the end of the process liquid phase is discharged into the system for wastewater treatment. If you are fed large amounts of brine are possible disruptions in performance of wastewater treatment, given that the insertion does not reduce chlorides in biological treatment, regardless of dilution.

The influence of the enzyme for the treatment of meat on the wastewater

In some European countries with lower quality beef treated with a special enzyme, in order to reduce the hardness and toughness. Due to the complex organic structure of the enzymes that come to cause an increase in wastewater biological oxygen consumption (BPK_5), and may endangerthe operation of devices for biological wastewater treatment.

Table 3.
The composition of waste water from cleaning smoke chambers

Parameter	Span
pH	12-14
HPK, mg/l	20.000-100.000
Phenol index, mg/l	20-480
Polyaromatic hydrocarbon, mg/l	1-5

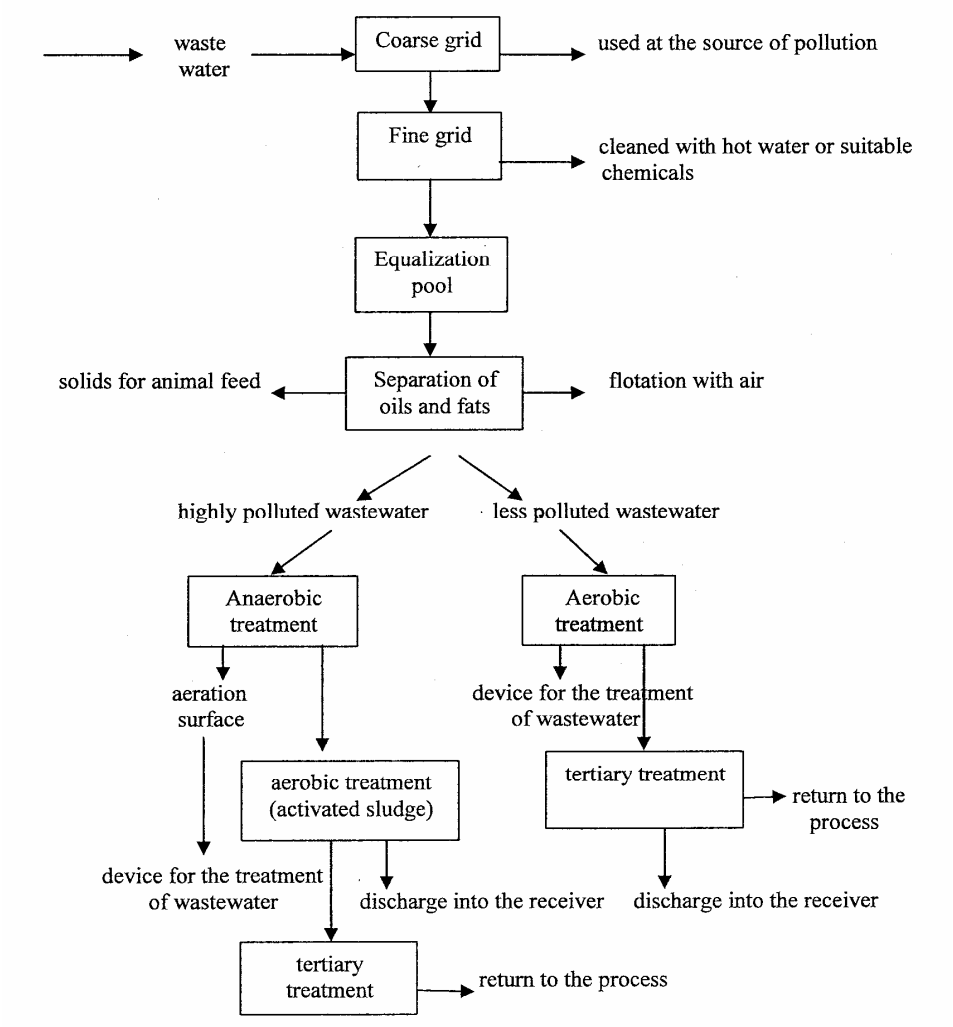

Figure 3. Schematic representation of technologies for meat processing wastewater

Waste water from cleaning smoke chambers

Washing of sediment that is deposited on the chamber walls resulting smoke heavily polluted waste water requiring special treatment (IPPC, 2008). In Table 3. shows the average composition of waste water resulting from washing the smoke chamber.

Waste water from cleaning equipment and work surfaces

All lines, equipment and work surfaces that are not marked as a "dry", require wet cleaning. Wastewater from cleaning equipment and work area contamination is raw materials, finished products and cleaning agents. If the solid waste enters the sewage system, there is an increase of chemical oxygen consumption (HPK), suspended particles, fats and oils in wastewater. Spices and additives that are added to meat during the washing of equipment and work surfaces are included in the wastewater (Okanović et al., 2010).

WASTE WATER TREATMENT

Release of wastewater from meat processing technological process, depends primarily on the recipient in which to indulge treated wastewater. If the recipient of the public sewerage system, which is associated with the urban condition of urban waste water treatment, then treatment consists only of pre–treatment. If the recipient of an open watercourse (river, lake, sea), wastewater treatment must be done at the secondary level (pre-treatment and biological treatment), in order to obtain the appropriate water quality. Figure 3. chart shows the wastewater treatment process meat processing.

EXTENT OF POLLUTION PREVENTION IN THE PROCESS OF MEAT PROCESSING

Prevention measures can be roughly divided into six groups:

1. General preventive measures

- the introduction of environmental management systems in the meat processing plant,
- replacement of hazardous chemicals in the process less damaging,
- continuous education of employees and well maintenance.

2. Reducing consumption of fresh water
- optimization of water use,
- water recycling.

3. Reducing energy consumption
- optimization of heating and cooling operations,
- installation of the drive frequency convector electric motors,
- installation of the battery to compensate for reactive power.

4. Reducing emissions in the air
- replacement substances that deplete the ozone layer,
- optimization of ignition and shutdown of boilers,
- recovery from boiler flue gases.

5. Reducing emissions to water
- reducing the use of chemical cleaning materials,
- recycling water where possible.

6. Protection of groundwater
- watch out for accidental expiration of chemicals from the tank.

Low water and waste water pollution can be achieved by applying certain measures in certain stages of production process and processing of meat:

1. Solid waste collected in special containers to prevent falling to the ground and coming to a device for wastewater treatment with water for cleaning work premises.
2. Liquid resulting squeeze meat from container handling before washing transferred to a separate dust container, so as not to due to a device for wastewater treatment.
3. In the meat during processing (cutting, skinning, removal of bone), bone and inedible waste is collected separately for further processing or disposal of animal waste in the landfill.
4. During the preparing of meat for the production of sausages, salami... behind the walls of vessels adhered mass that dries quickly and hard to clean. In order to shorten the time of cleaning, reducing water use and detergents, dry cleaning is re-

Table 4.
Reference value

Processing of meat		
Parameter	**Unit**	**Reference value**
Consumption of fresh water	m^3/t	6,0-10,0
Quantity of wastewater	m^3/t	10,0-25,0
Burden of waste water	kgHPK/t	0,8-2,5
Electricity consumption	kWh/t	1000-1300
Heat consumption	kWh/t	450-1000

commended dishes and utensils immediately after the cessation of work. Remains of ground meat should be removed by hand before washing.

In the process of processing of meat is most thermal energy is used in technological operations pasteurization and sterilization. By optimizing the operation of boilers and condensate return can reduce heating energy consumption per unit of product. Reducing energy el. energy per unit of production can be done in several ways: by installing compensating battery which eliminates payment of reactive power, installation of electric motors with frequency convectors rotation. They can regulate the speed of electric motors, according to the actual requirements of pump drives and can be easily automated and remotely managed (Okanović et al., 2011).

SPECIFIC INDICATORS OF THE MEAT PROCESSING

In the Document on Best Available Techniques in the Food Drink and Milk Industry issued by the EU (IPPC, 2008) lists the specific indicators for the given process. These values can be taken as reference (Table 4)

CONCLUSION

The introduction of the concept of BAT in the food industry requires a shift from previous practice of the domestic industry, which will have pollution prevention and waste incorporated into everyday practice.

This not only requires technological change, but to a greater extent and change behavior. Rising prices of energy and natural resources, the more expensive the actual production. It is the concept of BAT was shown in practice the EU, one of the responses that can reduce costs, achieve greater manufacturing performance, and reduce environmental pollution. It should be noted that the introduction of the concept of BAT other than finance, and time requirements, which requires the timely preparation of industry on the requirements placed upon them.

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ПРИМЈЕНА НАЈБОЉИХ РАСПОЛОЖИВИХ ТЕХНИКА ЗАШТИТЕ ОКОЛИНЕ У ИНДУСТРИЈИ МЕСА

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Сажетак: Принцип примјене најбоље расположивих техника (BAT) као скупа техничких мјера и поступака, као и начина њихове примјене све више се уводи у индустријску праксу. На нивоу ЕУ његова примјена дефинисана је примјеном Директиве о индустријском надзору и контроли онечишћења (Industrial Pollution Prevention and Control Directive; EC 2008/01), којом се комбинује превентивни и реактивни приступ онечишћењу. Законом о заштити животне средине, Република Српска је увела принцип BAT као најкориснији и најнапреднији развојни степен дјелатности и с њом повезаних начина производње и одржавања постројења који је доступан оператору и који може бити основа за одређивање граничних емисија којима се постиже спречавање, односно смањење утицаја на животну средину. Примјеном BAT постиже се висок степен заштите животне средине који се огледа у смањењу потрошње енергије и сировина, као и смањењу настајања емисија у животној средини. У раду је приказан технолошки поступак прераде меса. Такође су наведени референтни специфични показатељи животне средине, који се односе на потрошњу свјеже воде, потрошњу енергије, те количине и састава отпадних вода.

Кључне ријечи: најбоље расположиве технике, индустрија меса, IPPC директива.

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