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## ANALYSIS OF THE MANAGEMENT OF LIQUID EFFLUENT TREATMENT GENERATED BY THE SMALL PIG SLAUGHTERHOUSES OF CHAPECÓ – SC

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### **ABSTRACT**

This research sought to know the reality of small pig slaughterhouses, and its main objective was to analyze the liquid effluent treatment systems adopted by the small pig slaughterhouses located in the municipality of Chapecó-SC. It was necessary to identify the adopted treatment systems, to verify possible impacts caused by liquid effluents generated in the process, to specify the effective actions to minimize the environmental impacts caused by the generation of effluents and to evaluate whether the current structure, methods and procedures comply with the current legislation. This research is characterized as descriptive. The sample used includes six small slaughterhouses, located in the city of Chapecó-SC. For data collection, the semi-structured interview was used, carried out by the authors in visits “*in loco*”. For the analysis of the data the descriptive approach was used. The main results are knowledge about the adopted systems (physical and biological), the structures of the systems, with tanks and boxes of sand and stone, as well as ponds of treatment, risks and impacts, as well as actions that companies adopt to mitigate them. Also worthy of note is the relation of the current situation of the treatment systems adopted by the companies with the relevant legislation.

**Keywords:** Environmental Management; Wastewater treatment; Small Poultry Slaughterhouses.

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## 1. INTRODUCTION

Environmental problems are becoming increasingly critical and frequent due to population growth coupled with increased industrial activity. The impacts of these problems can be observed by changes in soil, air and water quality. In conjunction with these problems, there are worrying predictions for the coming decades, based on scientific studies that point to poor water quality, reduced numbers of species, desertification, silting and, the most seriously the shortage, highlighted by the increasing demand of water for industrial purposes and for the supply of households. Among these impacts, it is verified that the contamination of the waters has been one of the great environmental problems of the present time (Melo, 2012).

It should be noted, however, that not all industries generate effluents with impact power. First, it is possible to imagine that the procedures and activities of controlling each type of effluent in the industry are simple. However, the different physical, chemical and biological compositions, the volume variations generated in relation to the duration of the production process, the toxic potential and the different generation points in the same processing unit recommend that the effluents be characterized, quantified and treated and/or properly conditioned prior to their final disposal in the environment. According to Ghandi (2005), one of the main objectives of treatment systems in the animal slaughtering segment is to ensure the use of adequate treatment of the effluent, avoiding that its release into the environment causes damages of a sanitary or environmental nature.

Industries use water in a variety of ways and purposes and they can be: incorporation into the product; machine, pipe and floor washing; water from cooling systems and steam generators; water used directly in the stages of the industrial process or incorporated into the products and sanitary sewers of the employees, being thus one of the major responsible factors for the pollution and contamination of the waters, when the effluents without proper treatment in the natural water courses were launched, causing a series of damage to the environment and population. The effluents of abattoirs are among the main agro-industrial evictions that need special attention to avoid water pollution.

In this context, in the western region of Santa Catarina, more precisely, in the Chapecó micro region, there is the presence of large agro-processing industries. These companies have treatment of tributaries and effluents, according to the current environmental legislation. Many papers and scientific studies have already been published, taking into account the processes of these large

companies. However, in this same region, there are small agribusinesses about which there is not much knowledge, specifically regarding the processes and procedures adopted for their treatment of tributaries and effluents. Nevertheless, the importance that the agroindustry has for the municipality of Chapecó, which is a major agro industrial hub of Santa Catarina and is considered a region of large companies producing and exporting poultry and pork meat in the country, should be highlighted. Agro industrial activity was the main responsible for the economic development and the process of urbanization of the municipality and region.

Regardless of the size of the agribusiness or the number of employees, the company must follow the norms in force in the specific legislation, so that it can work with seriousness, improving its production systems more and more. From this context, this study has as general objective to analyze the systems of treatment of liquid effluents adopted by the small slaughterhouses of pigs located in the municipality of Chapecó - SC. The following specific objectives were outlined for its service: to identify the treatment systems adopted and the structure of these systems in small pig slaughterhouses; to verify possible environmental impacts caused by liquid effluents generated in the process; to specify the effective actions to minimize the environmental impacts caused by the generation of effluents; and to assess whether the current structure, methods and procedures comply with current legislation.

## 2. THEORETICAL REVIEW

### 2.1 Environmental management

Environmental management consists in the administration of the use of environmental resources, through actions or economic measures, investments and institutional and legal potential, with the purpose of maintaining or recovering the quality of resources and social development (Campos, 2002). In the same direction, for Ruppenthal (2014), environmental management, from the perspective of the administration of economic and social activities, aims to use the natural resources in a rational way. Over the years, it has become indispensable in any type and size of organization.

For Barbieri (2004, p. 137) "environmental management system is a set of interrelated administrative and operational activities to address current environmental problems or to prevent their emergence." Therefore, the objective is to constantly seek the improvement of quality related to the environmental issue of the services



and work environment of any organization. However, for this to become possible, it was necessary to create standards, with governmental support, making it possible to recommend the results of activities related to environmental management.

In this sense, according to Theodoro (2010), the current rules impose that the release of any waste can happen as long as they meet the conditions laid out in specific resolution. In order for industries to meet the standards established by environmental laws and to minimize the impacts generated on ecosystems, various methods of effluent treatment may be employed.

According to Ribeiro (2005: 144), "management activities should be structured according to the characteristics of each company, type of activity, size, and involvement with the environmental proposal, among others. The purpose of this structuring is the management of industrial activities". Moreover, for Ruppenthal (2014), the practice of environmental management allows the reduction of costs by reducing the waste of raw materials and resources, representing gains for the company.

### 2.1.1 Environmental impact

According to Sánchez (2013), the term environmental impact is used when some modification occurs, most often damage, to nature. According to Breda (2015), the environmental impacts on water resources affect the quality of life of the population and the environment. In this same direction, Pereira (2004, p.23) states that "water pollution comes from practically all human activities, be they domestic, commercial or industrial. Each of these activities generates characteristic pollutants that have a certain implication in the quality of the receiving body.

According to Sánchez (2006, 2013), when assessing environmental impact, consideration should be given to the scope of related environmental plans and programs. A good project, if developed in the wrong way, without considering equivalent environmental standards, can cause great repercussions and negative consequences to those involved.

The environmental impact study highlights environmental degradation, which is a term whose connotation is clearly negative, usually associated with changes and/or disturbances caused by the human agent. According to Sánchez (2006: 26) "natural processes do not degrade environments, they only cause changes". In this sense, degradation can be defined as any adverse change in processes, functions or environmental components, or as an adverse change in environmental quality, corresponding, therefore, to a negative environmental impact.

For Sánchez (2006, 2013), environmental impact is generally found in companies and, most of the time, damage to nature, such as wildlife mortality, occurs after oil spills into the sea or river. Situations typically described as environmental aspects are the emission of pollutants and generation of waste. The production of liquid effluents, air pollutants, solid waste, among many others, is part of the human activities and is related to the productive processes. Because they are elements that can interact with the environment, they are called environmental aspects. Other environmental aspects are those related to the consumption of natural resources, such as the consumption of water and fuels, reducing their stocks and their natural availability, part of which will be inseparable from the environment.

### 2.1.2 Water in nature

The study of water quality is important both to justify the consequences of a given polluting activity and to establish the means to satisfy a given water use. For Richter et Netto (1991, p. 1), because of its complexity, it is very difficult to see the water in a state of absolute purity, since it is composed of 33 different substances, numerous impurities that can be found in natural waters, from the innocuous, the desirable and the dangerous, among which we can mention viruses, bacteria, parasites, toxic substances and even radioactive elements.

Several parameters are used to characterize the water. These parameters indicate the water quality and constitute non-conformities when they reach higher values than those established for a certain use. The physical, chemical and biological characteristics of the water are associated to a series of processes that occur in the water body and in its drainage basin (Brasil, 2014).

- a) Impurities found in water: the degree of impurities present in water can be altered by different components in terms of their physical, chemical and biological characteristics. According to Sperling (2005), these characteristics can be translated in the form of parameters of water quality, such as: (i) physical characteristics: the impurities focused from the physical point of view are associated, for the most part, with the solids present in the water; (ii) chemical characteristics: the chemical characteristics of water can be interpreted into two different classifications - organic or inorganic matter; (iii) biological characteristics: beings present in water can be living or dead. Among living beings, there are those belonging to the animal and plant kingdom.



- b) Solids present in water: with the exception of dissolved gases, all other contaminants in the water contribute to the solids loading. For this reason, the solids are analyzed separately and are classified according to the physical and chemical characteristics. The physical characteristics are separated by size and state, since particles of different sizes can undergo different treatment processes. For Sperling (2005), the terms “filterable” and “non-filterable” are used, considering that the smaller particles are able to pass through a filter, while the larger ones are removed by the same filter.
- c) Organisms present in water: in the case of microorganisms, microbiology is cited as the branch of biology that studies them. When water quality is assessed, microorganisms play a very important role, since they are predominant in certain environments, since they work in the purification of waste or are associated with water-related diseases (Sperling, 2005).

Aiming to translate the physical, chemical and biological characteristics of water, several parameters are evaluated in specialized laboratories. According to Jordão et Pessoa (2005, p.19), “water quality parameters are quantities that indicate the characteristics of water or sewage, or bodies of water (...)”. According to Sperling (2005), such parameters can be of general use; serve to characterize water supply, wastewater, springs and receiving bodies. For the author, the assessment of water quality standards should follow the parameters available in the country, such as:

- Portability standard: Ordinance No. 518 (2004), of the Ministry of Health;
- Water bodies’ standards and launch standards: Resolution CONAMA 357 (2005), of the Ministry of the Environment, and eventual state legislations. This resolution defines the portability standard for drinking water and also addresses the release of treated effluents;
- Jordão et Pessoa also indicate Resolution CONAMA 274 (2000), which defines bathing standards in water bodies;

### 2.1.3 Effluent treatment

Industrial processes can be cited as one of the major factors responsible for the generation and release of effluents without due treatment, causing pollution and

contamination of the water, as well as a series of other damages to the environment. Emphasis is given to agro-industrial effluents, since these deserve high attention in order to avoid water pollution through the effluents generated by slaughterhouses (Braile et Cavalacanti, 1993). In the same direction, for Henares (2015), the industries are mainly responsible for the contamination of the water, due to the discharge of effluents in the water courses without the appropriate treatment, or inadequately deposited in the soil, causing serious damage to the environment, contaminating the soil and surface water and groundwater, making them unfit for use and also generating health problems for humans.

For Jordão et Pessoa (2005), in the same way that the pollutants contained in the sewage are of the physical, chemical and biological nature, the treatment processes can be classified in: physical, chemical and biological processes. For the authors, these processes do not act alone, because the transformations provoked by one of them will indirectly influence the other processes, and may alter some of their characteristics.

- a) Physical processes: the physical processes aim to remove suspended, sedimented and floatable coarse solids present, especially by physical-chemical action, using the equipment, piping and other units of the treatment system. In slaughterhouses, residues from fat, bones and meat can be retained at the place where they were generated, through the use of grids in outlet pipes (Philippi, 2004). The physicochemical processes are basically used to separate solids present in the effluents, also aiding in their equalization and homogenization.
- b) Chemical processes: the use of chemicals in treatment processes is necessary to remove substances, transform their state or structure or simply change their chemical characteristics (Philippi, 2004). According to Antonioli et al. (2003), chemical substances are added to facilitate the separation of the suspended solids and substances that cause the turbidity, aiming to increase the mass of the particle, becoming bigger and heavier, liable to sediment more quickly. According to the authors, this is possible through coagulation, which consists of the annulment of repulsive forces, and flocculation (increase in the cohesion force of the flakes formed in the coagulation), becoming denser and increasing sedimentation velocity.
- c) Biological processes: biological processes are those that depend on the action of aerobic or anaerobic microorganisms. If there is free oxy-



gen (dissolved), the aerobic bacteria generate decomposition. However, when there is no free oxygen, decomposition occurs through the action of anaerobic bacteria. Under natural conditions, aerobic decomposition requires three times less time than anaerobic and carbon dioxide, water, nitrates, and sulfates, which are harmless substances useful to plant life, result from anaerobic decomposition. The result of anaerobic decomposition is the generation of gases such as hydrogen sulfide, methane, nitrogen, ammonia and others, many of which are ill-smelling (Fernandes et Lopes, 2008).

### 2.1.4 Characteristics of slaughter house effluents

The analysis of the characteristics of the slaughter house effluent depends very much on the operational situation of each establishment and, therefore, can be a complicated task. The effluents resulting from the slaughtering processes are usually divided into two lines; the green line and the red line. In the green line are discharged liquid effluents that do not contain blood, that is, that are generated in areas where processes that involve the washing of blood do not occur. However, in the red line there are effluents containing blood. Although separated, the initial effluent treatments of the two lines are quite similar and have the same objective: to facilitate and promote a better primary treatment through biochemical processes to guarantee a biological treatment, which occurs after the equalization of the lines (Pacheco; Yamanaka, 2008; Morales et al., 2009; Cardoso, 2015).

According to studies by Espinosa (1998), a large number of small meat processing agroindustries find it difficult to adequately allocate the waste generated by the activity. However, according to the author, the question of the use of water has become a factor of fundamental importance, because this activity uses water in abundance, in all stages of the process. Complementing, for Braile et Cavalcanti (1993), water consumption is large and can vary greatly from company to company.

According to Imhoff et Imhoff (1998), industrial wastes, especially those that produce stench, such as the slaughter houses' dumping, should not be discharged into the sewage collection network, but rather disposed of directly in treatment plants. According to Jordão et Pessoa (2005: 863), "(...) all forms of industrial dumping can reach a sewage treatment plant in the public network provided that the networks are sized to receive such a contribution, (...)".

For Sperling (2002), among the treatments of the effluents of slaughterhouses, the anaerobic pond system is cited as being the most appropriate, followed by facultative ponds (anaerobic). However, it is important to point out, according to Imhoff et Imhoff (2002, p. 214), that "the degree of treatment that must be given to wastewater depends on the quality specifications attributed to the receiving watercourse. A certain amount of dilution applied to the effluent flow of a treatment plant has been prescribed for a period of time, relating the average of 24 hours worked with the average of the minimum flows of the receiving courses.

According to Jordão et Pessoa (2005: 867), "industrial dumps are characterized by a huge variety of pollutants, both in type and composition, and in volumes and concentrations. It varies from one industry to another, even within the industry itself, occurring daily and hourly variations, causing each case of industrial pollution to be investigated individually".

It is found that analyzing the characteristics of the slaughter house effluent is an essential task to determine the appropriate treatment. Table 1 presents the advantages and disadvantages of treatment systems, according to Sperling *apud* Maria (2008).

## 2.2 Environmental legislation

The environmental legislation has, among its objectives, the goal to establish parameters for companies to properly treat their effluents, respecting the receiving body. According to Jordão et Pessoa (2005, p. 115), "the criterion for selecting the type and degree of treatment are also related to the requirements of environmental legislation, whose fundamental part, in the federal scope, in Brazil, is Law 6,338, of August 31, 1981, which establishes the *Política Nacional do Meio Ambiente* (PNMA - National Environmental Policy), and Decree No. 99,274 of June 6, 1990, which regulates the law". PNMA has, among other instruments, the establishment of environmental quality standards; the assessment of environmental impacts; and the licensing of polluting activities.

According to Jordão et Pessoa (2005: 820), "federal legislation establishes microbiological standards for treated waters intended for public consumption. These standards are defined in Ministerial Order 1469/2000 of the Ministry of Health, according to which such standards must be absent from any type of coliform." Decree 30.691/52, which regulates the industrial and sanitary inspection of products of animal origin - RIISPOA, in its chapter I, Article 21.



System	Advantages	Disadvantages
Facultative Pond	<ul style="list-style-type: none"> <li>Satisfactory efficiency in the removal of biochemical oxygen demand</li> <li>Reasonable efficiency in pathogen removal</li> <li>Simple construction, operation and maintenance</li> <li>Reduced deployment and operational costs</li> <li>Absence of mechanical equipment</li> <li>Virtually zero energy requirements</li> <li>Satisfactory resistance to load variations</li> <li>Removal of sludge required only after periods of more than 20 years</li> </ul>	<ul style="list-style-type: none"> <li>High area requirements</li> <li>Difficulty in meeting restrictive release standards</li> <li>Operational simplicity can bring rest to maintenance (vegetation growth)</li> <li>Possible need to remove algae from the effluent to meet strict standards</li> <li>Variable performance with the climatic conditions (temperature and insolation)</li> <li>Possibility of insect growth</li> </ul>
Facultative Anaerobic Pond	<ul style="list-style-type: none"> <li>Idem facultative ponds</li> <li>Area requirements lower than single facultative ponds</li> </ul>	<ul style="list-style-type: none"> <li>Idem optional ponds</li> <li>Possibility of bad odors in the anaerobic pond</li> <li>Need for a reasonable distance to surrounding residences</li> <li>Need for continuous or periodic removal (interval of a few years) of anaerobic pond sludge</li> </ul>
Facultative Aerated Pond	<ul style="list-style-type: none"> <li>Relatively simple construction, operation and maintenance</li> <li>Area requirements lower than facultative and anaerobic-facultative pond systems</li> <li>Greater independence of climatic conditions than facultative and anaerobic-facultative pond systems</li> <li>Satisfactory resistance to load variations</li> <li>Reduced chances of bad odors</li> </ul>	<ul style="list-style-type: none"> <li>Introduction of equipment</li> <li>Slight increase in sophistication level</li> <li>Area requirements still high</li> <li>Relatively high energy requirements</li> <li>Low efficiency in the removal of coliforms</li> <li>Need for continuous or periodic removal (interval of a few years) of sludge</li> </ul>
Full Mix Aerated Pond - Decanting Pond	<ul style="list-style-type: none"> <li>Idem optional aerated Ponds</li> <li>Minor requirements areas of all pond systems</li> </ul>	<ul style="list-style-type: none"> <li>Idem optional aerated Ponds</li> <li>Quick fill of decantation ponds with sludge (2 to 5 years).</li> <li>Need for continuous or periodic removal (2 to 5 years) of the sludge.</li> </ul>
Maturation Pond	<ul style="list-style-type: none"> <li>Idem system of previous ponds</li> <li>High efficiency in the removal of pathogens</li> <li>Reasonable efficiency in nutrient removal</li> </ul>	<ul style="list-style-type: none"> <li>Idem system of previous ponds</li> <li>Rather high area requirements</li> </ul>

**Table 1.** advantages and disadvantages of treatment systems

Source: Sperling *apud* Maria (2008, p. 18)

Since Federal Law no. 6,938, dated August 31, 1981, environmental licensing is one of the most important PNMA instruments for the control of effective or potentially polluting activities, basically being an activity to be exercised by the State Public Power, according to the legislation cited and according to the dictates of CONAMA Resolution no. 237 of December 18, 1997. According to Maldaner (2008), this environmental licensing obeys the legal precepts, in addition to clearly established administrative and ritual rules, being increasingly integrated with the perfective action that causes or may cause significant changes in the environment, with repercussions on environmental quality.

Pacheco (2006) cites the CONAMA Resolution no. 357 of March 17, 2005, which was created to establish the framing and classification of the water, volume released and its regime of variation, in addition to the physical-chemical and biological characteristics of the effluent, aiming to preserve and recover the production of drinking water. In addition to these factors, this resolu-

tion determines tasks, responsibilities and penalties for non-compliance with the deadlines stipulated by it, also providing for: classification of water bodies and environmental guidelines for their framing; and effluent release conditions and standards.

Despite the difficulty that some companies face in characterizing their effluents and in determining the best form of treatment, according to Jordão et Pessoa (2005), the legislation can help these organizations to fulfill their obligations regarding environmental preservation, without affecting the performance of their production.

### 2.3 Slaughter of pigs

Slaughtering of pigs can be carried out by slaughterhouses, whose final objective is the generation of pig carcasses, or by abattoirs that, in addition to slaughtering, process the carcasses, producing cuts with or without bone, and other industrialized products, such as built-in

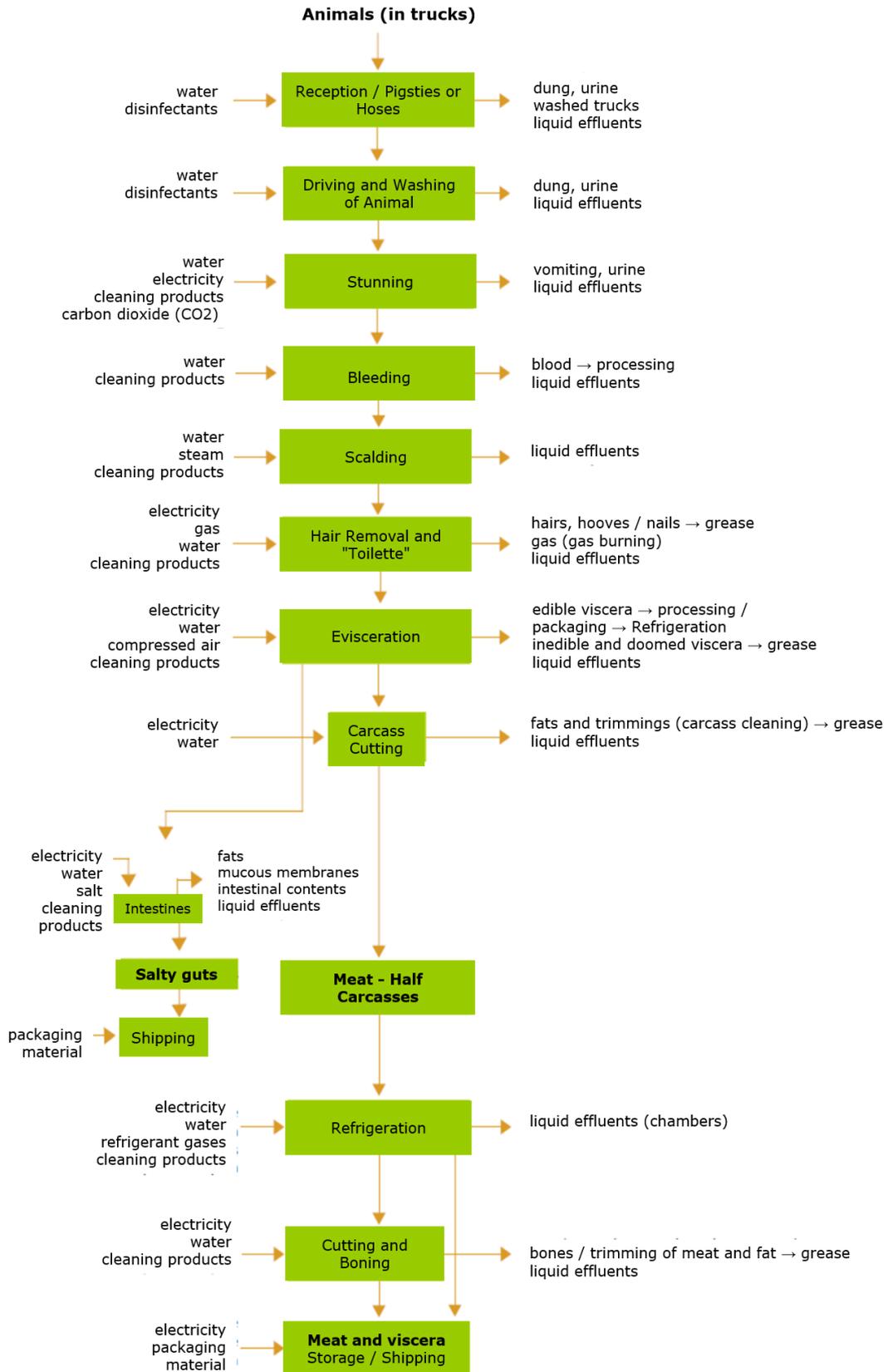


Figure 1. Swine slaughter flowchart

Source: Pacheco (2016)



food. The stages of pig slaughtering are divided according to the flowchart in figure 1, in which it is possible to verify the stages, from the reception of the animal to the storage and dispatch of the finished product, the points that consume water and the points that generate solid and liquid effluents.

### 3. AGROINDUSTRIES OF MEAT PROCESSING

The production and processing of meat in Santa Catarina originated, on a commercial scale, with the transformation of pork. In the second half of the nineteenth century, many settlers settled in the Itajaí Valley (mostly German immigrants) producing meat and marketing the surplus.

Due to the industrialization and urbanization of the region, the expansion of the local market resulted, in the 1870s, in the first company producing pork products (Carvalho Jr et al., 2007).

At the beginning of the 20th century, there was the displacement of swine breeding from Vale do Itajaí to the West and Vale do Rio do Peixe. These regions experienced a rapid demographic increase due to the migration of farmers from Rio Grande do Sul. This new contingent was formed by colonists of Italian and German origin, with a strong tradition in the polyculture and breeding of pigs, poultry and cattle.

A determinant factor of the expansion of agro-industrial activity in the Santa Catarina region, according to Carvalho Jr et al. (2007) was the beginning of the construction of the São Paulo - Rio Grande Railroad in 1906. The company responsible for building the railroad also obtained the concession of lands located along the railroad and began to colonize them, a fact later intensified with the establishment of other companies specializing in these activities.

When identifying a good business opportunity, traders came and bought the pigs from the local producers and sold them in São Paulo, where they brought manufactured products. From the late 1930s to the early 1950s, several of these merchants, from the capitals accumulated in commercial activity, set up small businesses such as wheat mills and slaughterhouses. It was during this period that the main companies of the meat industry of Santa Catarina were inaugurated, such as Perdigão (1934), Sadia (1944), Coopercentral (1950), and Seara (1956).

The municipality of Chapecó is considered today a great business center in the state of Santa Catarina. Several segments of the industry stand out in this sector, such as the

furniture industry, metal mechanics and undoubtedly the agroindustry, especially the production, industrialization and commercialization of meat products.

In addition to the large agribusinesses that stand out, the municipality has a structure, from inputs, packaging, machinery and equipment, fomenting the formation of small and medium-sized agro-processing industries, which contribute to the development of the city and region.

### 4. METHODOLOGICAL PROCEDURES

This is a descriptive field survey that uses a qualitative approach. This type of research aims to describe, in detail, the facts and phenomena of the studied reality, aiming to obtain information about what was defined as a problem or opportunity to be investigated (Triviños, 2007; Gil, 2008).

Regarding the cut, this study is transversal and, according to Richardson (1999), refers to the surveys whose data are collected at a point in time, based on a sample selected to describe a population at that particular moment

For data collection, a semi-structured interview with the agribusiness managers was used, through a sense. Seven companies were sampled; however, one of them chose not to participate in the survey, leaving six companies. For the definition of the population and sample, data were used from the Municipal Department of Agriculture, which provided the listing of the companies. On-site observation and documentary research were also used to identify data on the treatment of tributaries and effluents, from entities such as the *Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina* (EP-AGRI - Agricultural Research Company and Rural Extension of Santa Catarina), the *Associação dos Pequenos Agricultores do Oeste Catarinense* (APACO - Association of Small Farmers West of Santa Catarina) and the Municipal Government of Chapecó. Relevant legislation was also sought to make comparisons with the current situation of companies. The possibility of obtaining additional information, not foreseen during the elaboration of the interview script/instrument, was a great advantage of the semi-structured method.

After data collection, the data were organized so that the information needed to answer the research question of this study could be extracted. In this stage of the research, the data were exposed, relating the answers obtained with the application of the interviews to the proposed objectives, through tables used to classify the data, facilitating the interpretation of the reader, and



enabling a better visualization and understanding of the project at hand. After tabulation of the data, descriptive analyzes were performed, based on the study objectives.

## 5. PRESENTATION AND ANALYSIS OF DATA

The companies are classified as company 1, 2, 3, 4, 5 and 6 for data presentation. This classification, which was necessary for a better presentation of some questions, refers to the order in which the research was carried out and has no relation to the efficiency of treatment or results.

With respect to the characterization of the companies surveyed, all of them are located in districts, rural areas or neighborhoods of the municipality of Chapecó, namely: two slaughterhouses in Vila Monte Alegre founded in 1985 and 1997, a slaughterhouse in Linha Simonetto, founded in 2003, a slaughterhouse in the Palmital neighborhood, founded in 1980, a slaughterhouse in Linha Colônia Cella, founded in 1997 and, finally, a slaughterhouse in the Esplanada neighborhood, founded in 1996.

With regard to the interviewee's role, all are managers of the companies surveyed. After the initial characterization, the managers were asked about the number of employees of the companies, as shown in table 1.

**Table 1.** Number of employees

Number of employees	Quantity	%
Between 1 and 5	1	17%
Between 6 and 10	3	50%
Between 10 and 15	1	17%
Between 15 and 20	1	17%
TOTAL	6	100%

Source: The authors themselves

The characterization of the effluent treatment system refers to the treatment system adopted by the companies and it was evidenced that 100% of them use a physical system, followed by a biological system. The process of treatment of effluents, in all the companies, starts with the grease box, followed by the tanks and ponds of treatment of the liquid effluents. They differ in visual aspects. It is not possible to infer evaluation as to the efficiency of the systems, due to the fact that no documentary research was carried out in the company's records and no collection of material for analysis, due to lack of permission.

Following, the companies were questioned regarding the structure of their treatment systems and it was evidenced that 40% use sand/stone boxes and 60% use boxes of fat for the physical treatment systems. For bio-

logical treatment systems, all companies use anaerobic treatment ponds.

It is noteworthy that, as mentioned by the author Sperling (2002), among the treatments of effluents from slaughterhouses, the most appropriate is the anaerobic pond system, followed by facultative (anaerobic) ponds. According to Imhoff et Imhoff (2002, p.214), "the degree of necessary treatment that must be given to wastewater depends on the quality specifications attributed to the receiving watercourse (...)".

The following questions are descriptive and the answers are presented in the sequence.

**Table 2.** Basic procedures for acquiring physicochemical wastewater data

Question 2.3	Responses
Does the slaughterhouse follow a standard, basic procedure for acquiring the physical-chemical data of the wastewater? If so, which ones?	Company 1: "Yes. I carry out upstream and downstream analyzes."
	Company 2: "Yes. We collect all the gross waste (blood, fat), removing them by means of outsourced company."
	Company 3: "Yes. We follow the necessary treatment, with analysis following the legislation standards."
	Company 4: "Yes. It accompanies BOD and COD with analyzes every two years, according to the legislation."
	Company 5: "Yes. By means of comparative analyzes with the legislation, verifying the pH and turbidity and also by visualizing the color, before dropping to the receiving body, that is, the river."
	Company 6: "Yes. System input and output analysis."

Source: The authors themselves. BOD - biochemical oxygen demand; COD - chemical oxygen demand

In question 2.3, companies say they follow all possible procedures for acquiring the physicochemical data of the water before its launch, but it is noticed, through the answers obtained compared with the resolution of CONAMA, that the care in all the companies still need to improve.

CONAMA Resolution No. 274 of November 29, 2000) provides that:

Considering Law 6.938 of August 31, 1981, which aims to control the release of pollutants into the environment, prohibiting the release at harmful or dangerous levels for humans and other forms of life; that the frame-



work expresses the final goals to be reached, and it is possible to set intermediate, mandatory, progressive goals for its implementation and that the set of water quality parameters selected to subsidize the proposed framework should be periodically monitored by the Government. Parameters whose presence or non-conformity are suspected should also be monitored and the results of monitoring should be analyzed statistically and measurement uncertainties should be considered.

**Table 3.** Methods used to analyze the progress of the management of the generated effluent.

Question 2.4	Responses
What method is used to analyze the good progress or good management of the generated effluent?	Company 1: "Take care of the time, the hygiene, the waste; daily cleaning of residues in grease boxes; check pipes and, if damaged, make repairs."
	Company 2: "Viewing daily, wiping around tanks and grease boxes."
	Company 3: "Cleaning the grease boxes, when necessary, not to overflow, and visualizing the other stages of the process daily."
	Company 4: "Visual method and collection of water samples to see their turbidity."
	Company 5: "Collection of coarse residues, maintenance of boxes and cleaning of tanks; the color of the water should be analyzed."
	Company 6: "Analyzes."

Source: The authors themselves

When questioned about the method used to analyze the good progress or good management of the generated effluent, it was noticed that four companies cite the importance of keeping the grease boxes clean, collecting the coarse residues. The turbidity analysis is quoted twice, as well as sample collection for analysis.

At the time of the visits an observation was made in the processes and it can be verified that the abattoirs studied presented similar operational characteristics. However, company 1 should be emphasized, since it presented good treatment conditions, differing from those that operate in a precarious way, both in technological and structural aspects. The fact that they are considered small slaughterhouses cannot be a differentiating factor under legislation, that is, regardless of size, the effluent release standards, which are established by law, must be the same.

The author Espinosa (1998) cites the comment that there is a large part of small agro-industries of meat processing that finds difficulties to properly destine the residues generated by the activity. However, the use of

water is considered to be a fundamentally important factor, since the slaughtering and meat processing activities use plenty of water at all stages of the process and, therefore, should adopt appropriate procedures for the treatment of the effluents generated in their processes.

It is clarified that, although the treatment systems evaluated in this study present poor visual appearance, it cannot be concluded that they do not meet the current standards. For this, it would be necessary to evaluate the physical-chemical and microbiological analyzes, which the researcher had no access in any company.

Question 2.5 sought to know whether the company identified sources of possible environmental impacts.

**Table 4.** Identification of activities that cause adverse environmental impacts to the environment

Question 2.5	Responses
Has the company identified its activities that cause adverse environmental impacts to the environment? If so, what are they?	Company 1: "Yes. Blood, waste remnants, grease and leakage in tanks."
	Company 2: "No."
	Company 3: "Yes. Fat and residues."
	Company 4: "Yes. Waste."
	Company 5: "No."
	Company 6: "No."

Source: The authors themselves

It is verified that only 50% of the companies stated they have already identified the activities that cause environmental impacts. The negative in this question is not enough to conclude that the companies do not take actions to prevent impacts.

It should be noted that, as established by CONAMA, in its Resolution no. 357, of March 2005, Article 46, and Paragraph 1:

**Art. 46** - The person responsible for potentially or effectively polluting sources of water must submit to the relevant environmental agency, by March 31 of each year, a declaration of pollution load, referring to the previous calendar year, signed by the company's principal administrator and by the duly authorized technical officer, together with the respective Technical Responsibility Note.

**§ 1°** - The declaration referred to in the caput of this article shall include, among other data, the qualitative and quantitative characterization of its effluents, based on their representative sampling, the state of maintenance of



the equipment and the pollution control devices.

In order for the company's technical director to issue such a declaration, it is necessary to know the sources of pollution of the company, in addition to the characteristics of the effluents, according to Nunes (2004), when he says that the knowledge of the characteristics of the wastewater industry is the first step to select the best form of treatment, in addition to the need for the company to give importance to the potential pollutant of its effluents, when these effluents are released into the body of receiving water.

Question 2.6 asked whether the slaughterhouse periodically monitors its liquid effluents and the receiving body. All companies answered yes to this question, that is, they monitor it periodically. In this same question we tried to know the reason of the company to monitor it and the answers are presented in table 5.

**Table 5.** Realization and reasons for the periodic monitoring of the liquid effluents and the receiving body

Question 2.6	Responses
Does the company periodically monitor its liquid effluents and the receiving body? Why?	Company 1: "Yes. In addition to preserving the environment, we have bred fish, ducks and geese in the last tanks."
	Company 2: "Yes. Because there is a huge charge for waste and effluents discarded by the company."
	Company 3: "Yes. Because there is a fine if the disposal of water, which is made next to residences that use water for other purposes, is not done correctly."
	Company 4: "Yes. Due to the fines that can be generated if it is not appropriate."
	Company 5: "Yes. There is a lot of charge on this environmental issue."
	Company 6: "Yes. Reason for the great contamination that our water can cause to rivers."

Source: The authors themselves

From the answers obtained in this issue, especially from the companies 2, 3, 4 and 5, there is a concern to monitor the liquid effluents in order to avoid fines due to the existing collection in relation to the environment. It was established by CONAMA, in its Resolution no. 357, dated March 2005: "Art. 48 – Failure to comply with the provisions of this Resolution shall subject violators, among others, to the penalties provided for in Law No. 9,605 of February 12, 1998 and respective regulations." One of the forms of application of these penalties is the fines to the infringing companies.

On the other hand, companies 1 and 6 emphasize the importance of preserving the environment, and this concern is not only linked to fines or charges. In company 1, an adequate environment was observed, especially in the final treatment ponds, where, as the interviewee himself commented, it is possible to observe fish breeding and the presence of other animals, such as ducks and geese, demonstrating the presence of oxygen in the water, before returning it to the receiving body.

Despite the good performance perceived in the treatment of liquid effluents from company 1, the others did not present the same result. It was observed incidence of leaks in the lagoon of treatment in one of the companies. It is noteworthy that from this pond the water is directed to the receiving body.

Also with regard to question 2.6, we sought to know whether the results of monitored liquid effluents present results compatible with legal standards. All respondents respond positively. Complementing this question, we sought to know the reason for the positive result. Table 6 presents the results of this question, per company. It is confirmed that the interviewer did not have access to the analyzes to carry out documentary research, staying only with the verbal response of the interviewee.

**Table 6.** Compatibility of the results of the monitoring of the liquid effluents and of the receiving body with the legal standards

Question 2.6 (continuation)	Responses
If monitored, do monitored liquid effluents and the receiving body have results consistent with legal standards? Why?	Company 1: "Yes. Because we follow the legislation and use water for other purposes, such as breeding animals in the last pond."
	Company 2: "Yes. We follow all the results of the analyzes made with the legislation."
	Company 3: "Yes. Compared with the results of analysis with the legal standards."
	Company 4: "Yes. The analysis is done every two years."
	Company 5: "Yes. We follow through analyzes."
	Company 6: "Yes. Because we control the main analyzes such as pH and turbidity."

Source: The authors themselves

Issue 2.7 sought to know whether the company has an up-to-date inventory of all of its waste to properly dispose of or market them. For this question, 100% of respondents say they have the updated inventory. Again there was no access to documents to prove this information.



Question 2.8 sought to know the advantages and disadvantages of the effluent treatment system adopted by the company, in the manager's view. The answers are presented in table 7.

**Table 7.** Advantages and disadvantages of the treatment of effluents adopted, in the view of the manager

Question 2.8	Responses
Name the advantages and disadvantages of the effluent treatment system used in your company.	Company 1: "There are only advantages, because, in addition to preserving the environment, it does not create complications with legal bodies."
	Company 2: "Advantage is that, in this process, the pollution is minimal, without high costs, only costs for repairs. Disadvantage: cost of removal of waste by third parties."
	Company 3: "The advantage is the quality of the water released into the environment. Disadvantage: High labor cost."
	Company 4: "Advantage: at the end of the treatment the water can be reused. Disadvantage: when the water volume is high, the system cannot filter the residue well at the end of the treatment, and then it is dropped into the receiving body"
	Company 5: "After the structure is ready, it does not generate more costs, if well taken care of. Fish breeding at the end of the treatment. There is no disadvantage if the process is well done."
	Company 6: "Raising frogs and other animals at the end of treatment; Disadvantages: the water receives chemical used in the sanitation and cannot be removed if the process is not working well."

Source: The authors themselves

Question 2.9 refers to environmental risks and impacts in the effluent treatment systems adopted by the companies and the answers are presented in table 8.

**Table 8.** Existence of risks of environmental impacts in the effluent treatment systems adopted

There are environmental risks and impacts	Quantity	%
Yes	2	33%
No	4	67%
<b>TOTAL</b>	<b>6</b>	<b>100%</b>

Source: The authors themselves

According to the interviewees' answers, only two companies surveyed, or 33%, consider that there are risks of environmental impacts. Table 9 refers to the

types of risks in these two companies, also mentioned by the managers.

**Table 9.** Risks of existing environmental impacts

If there are risks, which ones?	Quantity	%
Grease, blood sent to ponds	1	50%
Infiltrations, excess spills, pipes that may burst	1	50%
<b>TOTAL</b>	<b>2</b>	<b>100%</b>

Source: The authors themselves

Question 2.10 identifies the actions that are being taken by companies to minimize the impacts caused by the generation of effluents. It should be noted that 100% answered this question and it is a question of multiple choice. Table 10 presents the answers obtained.

**Table 10.** Actions taken in the company to minimize the environmental impacts caused by the generation of effluents

Actions taken	Quantity	%
Compliance with legislation	6	18%
Appropriate treatment system	6	18%
Training of employees to carry out activities	6	18%
Employee training for emergencies	6	18%
Analyzes / tests for follow-up	6	18%
New technologies, aimed at reducing the amount of toxic products in the processes	0	0%
Rationalization of water consumption in processes	0	0%
Investments in improvements in the performance of the treatment system	0	0%
Preparation of working procedures and instructions	0	0%
All above	3	9%
<b>TOTAL</b>	<b>33</b>	<b>100%</b>

Source: The authors themselves

It is verified that, in relation to the actions taken in the company to minimize environmental impacts, the following stand out: compliance with legislation (18%), adequate treatment system (18%), training of employees to carry out activities (18%), training of employees for emergency situations (18%) and analysis and testing for follow-up (18%).

Regarding the existence of actions aimed at the environment, question 2.11 sought to know whether the companies surveyed have projects focused on environ-



mental preservation and awareness of the community and their employees. Table 11 and figure 5 present the results to this question.

**Table 11.** Existence of projects focused on environmental preservation and awareness of the community and its employees

Environmental projects and awareness	Quantity	%
Yes	5	83%
No	1	17%
TOTAL	6	100%

Source: The authors themselves

It is verified that only one company, or 17%, does not have any project aimed at preserving and sensitizing the community and employees in relation to the environment, while the other five companies, or 83%, have some project. To complement this question, we sought to know what projects the companies have. Table 12 presents the result. It is a matter of multiple choices.

**Table 12.** Types of existing projects

Environmental projects and awareness	Quantity	%
Reforestation	5	63%
Legal reserve	1	13%
Community Awareness	0	0,00%
Employee Awareness	2	25%
TOTAL	8	100%

Source: The authors themselves

Of the five companies that answered this question, the reforestation stands out with 63%; awareness raising for employees (25%); and the legal reserve (13%).

Complementing, managers were asked whether employees knew the company's main environmental aspects and impacts and mitigation proposals. All respondents answered yes to this question.

## 6. CONCLUSION

This study made it possible to know the reality of pork processing micro-enterprises in relation to their effluent treatment systems. Despite difficulties encountered in conducting the research, such as distrust on the part of the interviewees and the non-release of documents, such as the analysis of the amount and downstream to perform an adequate documentary research, one can respond to the specific objectives of the work.

From the list provided by the Municipal Department of Agriculture, the companies (address, telephone, owner) belonging to this study were accessed. All are classified as micro-enterprises (up to 19 employees, according to parameters of the Brazilian Service of Support to Micro and Small Enterprises - SEBRAE).

Initially, it was sought to know the systems adopted as well as the structure for treatment of liquid effluents from pig slaughterhouses, aiming at meeting the first specific objective. It was verified that the treatment system that prevails is the physical one, for the removal of the coarse residues, with the use of tanks or boxes of sand or stone, and biological, with the use of treatment ponds.

Following, the purpose of this study was to determine whether the company identified the possible risks of environmental impacts of its process, in order to meet the second specific objective. Regarding this objective, a question sought to know whether the company has already identified the activities that caused environmental impacts and it was verified that 50% of the companies surveyed said they had identified such activities.

With regard to risks, managers were asked if there are risks of environmental impacts caused by their activity. For this question, 33% said yes. The risks generated by grease and blood were mentioned, as well as infiltrations, excess effluent spillage and pipes that could burst. In order to minimize the risks of environmental impacts, companies carry out different actions, such as: complying with legislation, using an adequate treatment system, training employees to carry out activities and for emergency situations, as well as carrying out analyzes and tests for follow-up.

To meet the third specific objective, the interviewees were asked about the existence of actions focused on the environment. It is verified that 83% of the companies said they have projects aimed at preserving the environment, such as: reforestation, employee awareness and legal reserve. The managers also mentioned advantages and disadvantages of the systems adopted.

Finally, in order to meet the fourth and last specific objective, it sought to know whether the structure, methods and procedures for treatment of liquid effluents adopted by micro and small agro industries comply with the legislation. It can be concluded that they meet, however, still with a vision of compulsion and not of environmental conscience.

In general, it can be said that there are no large differences between the evaluated systems, except the com-



pany 1, as already pointed out, which stands out for the existing structure for the treatment of effluents.

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