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“CLEANER PRODUCTION INITIATIVES AND CHALLENGES FOR A SUSTAINABLE WORLD”

Water Management in the Tanning Industry – A Diagnosis under the Cleaner Production Principles in Sao Paulo State, Brazil

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Abstract

Water is an important resource for the tanning industry. Considering the increasing necessity of the rational use of water by the mankind, the aim of this work was to make a diagnosis of water management in the tanneries with beamhouse operations in the State of Sao Paulo, Brazil, under the focus of the Cleaner Production (CP). The methodology included the elaboration and application of a survey, evaluating management parameters, through interviews in 9 (nine) tanneries. The data analysis resulted in a 'water management traffic light', which shows the overall degree of this management. Results showed that although some good practices were found in these tanneries, generally the water management under CP is incipient.

Keywords: *water management, cleaner production, tannery, leather industry*

1 Introduction

Water, essential to the life, is a renewable but not limitless resource. The social perception of this fact has increased in recent years, as the pressure on the water resources grows in some regions of the planet.

The heterogeneous distribution of water offers and demand through the planet explains the apparent paradox *water planet with water scarcity*.

The population increase and the water bodies contamination contribute significantly for intensifying the water scarcity and the resultant conflicts in several regions of the planet. Thus, it is imperative to minimize potential risks of water scarcity and to break the paradigm of abundance of water, being effectively rationalized its use (Mierzwa and Hespanhol, 2005).

This implies to apply management instruments in water resources use. *Management* can be taken as synonymous by *administration*, which is the process of planning, organizing, directing and controlling the use of resources to reach objectives (Chiavenato, 2000).

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Applying this concept to the water resources, in a broad view, water management involves analytical and creative activity, aiming to the establishment of principles and directives as basis for normative document preparation, building of managerial systems and the decisions taking, which have as final objective to promote the *inventory, use, control and protection of the water resources* (Lanna, 1999).

Global Agenda 21, an important document which resulted from the United Nations Conference on Environment and Development (UNCED), also known as the Rio Summit, Rio Conference or Earth Summit (1992), in its item 18.3, places the importance of the *integrated management of water resources* to attend necessities and interests of the stakeholders which share these resources, in a sustainable way (Sao Paulo, [199-? or 200-?]).

The *integrated water management* encloses two main fronts:

- *Management of offers (or supplies)*: it includes policies and actions to preserve the current water sources, as well as identifying, to develop and to explore efficiently new sources; and
- *Management of the demand*: it includes mechanisms, actions and incentives that promote water conservation and the efficiency of its use, with the elimination or minimization of water wastes - *the rational use of water* (Salati *et al.*, 2006).

Within Brazilian legislation regarding water resources, it can be distinguished the federal law 9,433 (January 8th, 1997), which instituted the *National Policy of Water Resources* and created the National Water Resources Management System, among other items. In this law, it is raised the need of assuring the multiple uses of the water by society, as well as the recognition of its economic value. It is also distinguished the establishment of management instruments, as the information systems of water resources, the water resources plans (in the scope of the watersheds, the States and the country), the grant and the collection (taxes) for the water use (which can induce to its rational use) and the definition of the watershed as the territorial unit for *shared and integrated water management*, carried out by the watersheds committees. In such a way, law 9,433/97 encloses aspects of the integrated management of water resources, as much of the side of offers as of the demand (Brasil, 1997).

Industry uses water for diverse purposes in its activities and some industrial sectors make it intensively. In a general way, the structures found in the references for a *water management system* in the industry are similar to those for quality and/or environmental management systems, based on the *management of routine* and the *continuous improvement* (FIESP, 2004; Mierzwa and Hespanhol, 2005; Metcalf, 2009).

Freitas (2009) and GEMI [200-] point out the *enterprise management of water* in a broader and more strategic level, considering water management technologies for its conservation and reuse, as well as risks and opportunities identified from the local reality of water resources use.

WBCSD and IUCN (2009) put together and present 16 initiatives which were proposed by different organizations, directed to water management in companies, which contain since diagnosis tools of water use until aspects for its strategic management.

Therefore, it can be concluded that *the water management in an organization* would have to be established and directed to two basic points:

- *The rational use of water*, which comprises essentially: the conservation of water and the efficiency of its use, with elimination or minimization of water wastes, related to the management of demand; the practice of water reuse, in the viable and safe ways, contributing for the management of offer;
- The integration of the internal water management with the management of water in the community by participation in the watersheds committees.

Amongst the sectors that make intensive use of water, there is the leather production sector – represented by the tanneries. Estimations show that for producing 1 kg of finished bovine leather, from 4 kg of salty bovine skin (conserved), it is necessary about 120 kg (or liters) of water. Considering an average weight of 25 kg for this skin, it would be necessary 750 liters of water to produce one bovine leather (Farenzena *et al.*, 2005).

The complete industrial process, from the conserved or "*in natura*" skins until the final leather, is divided in four basic macro-stages: beamhouse, tanning, wet finishing and final finishing. The macro-stage with the biggest water consumption is the beamhouse, responsible mostly for the cleanness of the skins, aiming at removing materials which are impurities for the final leather – 60 to 70% of the total water consumption in the complete processing occurs in this macro-stage. There are tanneries which carry out this processing and others that do only some of the four macro-stages (Pacheco, 2005).

In such a way, it is desirable that tanneries have an efficient water management system effectively implemented. However, there is a general perception that environmental management, and specifically water management, are still precarious in several companies of this sector. It occurs that there is not a clear picture or a reference on the current situation of water management practices and how these practices have evolved in the tanneries.

As counterpoint, one knows that some large tanneries, more structured and professionalized, and even some smaller ones, already present some process practices with positive impacts on the rational use of water. However, it is also unknown the degree and broadness in which this occurs.

Cleaner Production (CP), by its turn, is a strategy or tool of preventive management of the environmental aspects of the productive activities and of services, aiming at rationalizing its consumption of resources (including the water), eliminating or minimizing the use of toxic or dangerous substances to environment and to the man, as well as the generation of residues of any type (UNIDO, 2008).

Therefore, a diagnosis of water management in Sao Paulo tanning industry which performs the beamhouse steps would be important to guide eventual coordinated actions involving the leather production chain and the government to implant and to consolidate *the integrated water management* in this productive activity. In this direction, the CP concept and approach, applied specifically to the industrial water use, can contribute significantly for this task.

2 Methodology

The research approach of the present work is characterized as *descriptive* and *exploratory*.

The *method* used was a *survey by sampling*, to evaluate the water management behavior in the *Sao Paulo State tanneries which carry out the beamhouse*

operations (responsible for the biggest water consumption). This was the population for the sampling and it was conducted in a way to become the survey practically viable.

A not-proportional stratified sample was taken from this population, being 3 (three) companies of each one of 3 (three) strata related to the company size, in function of the production volume: *small* tanneries (S1, S2, S3), with production until 7,500 kg leather/day, around 300 bovine hides/day; *medium* (M1, M2, M3), with production above 7,500 kg leather/day and until 50,000 kg leather/day, typical units processing around 2,000 bovine hides/day; and the *large* ones (L1, L2, L3), with production above 50,000 kg leather/day, totalizing 9 (nine) tanneries.

The *technique* used for the research was *interrogation or interview*, by application and fulfilling of a survey form, consisting of aspects and parameters of water management, considering the CP principles – a *model* of this management, obtained from a literary review. Inductive aspects or factors and obstacles for the water management, as well as the integrated water management with the community were also questioned. The research procedure included a technical visit to the production installations in the nine companies, with focus in their water use and after that, the survey form was filled together the representatives of each tannery. Later, the filled data were compiled in descriptive and comparative pictures.

The following aspects and parameters constituted the survey form:

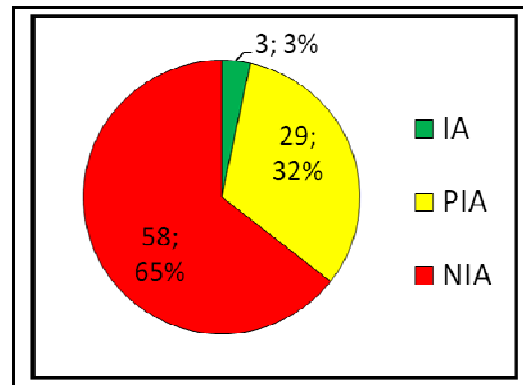
- General aspects
 - Routine of water use measurement and monitoring - quanti/quali, with evaluation;
 - Routine of effluents (wastewaters) measurement and monitoring - quanti/quali, with evaluation;
 - Operational control of water use (production processes and auxiliary operations);
 - Availability of a water use and wastewater balance or flowchart (“map of waters” of the tannery);
 - Routine of water and wastewater costs measurement and monitoring;
 - Periodic program or routine for combating water wastes, losses and leakages;
 - Objectives and goals for water use reduction or minimization;
 - Objectives and goals for effluent and/or its pollutant load reduction or minimization;
 - Specific indicators for monitoring the effluent, its pollutant load and the water use reduction;
 - Periodic training for the management and rational water use.
- CP actions related to water use in tanneries
 - Equipment/accessory which economizes water;

- Chemical products – strictly controlled, only the necessary amounts; minimization;
- Process controls - well controlled parameters - to maximize exhaustion of chemicals in the baths;
- Skins washings - in batches, with closed doors (closed water enter and solution/water exit);
- Treated wastewaters reuse - in the process and/or in auxiliary operations;
- Salt beating (from salty skins) before the process - beaten salt recycling;
- Skins pre-soaking practice, with soaking water reuse during a day;
- Liming/unhairing baths recycling - with hair recovery;
- Reuse/recycling of the washing waters from the deliming and bating steps;
- Shorter or lesser volumes baths, in the operational and quality limits of the skins;
- Pickling step - bath reuse/recycling;
- Pickling step - the possible shortest bath (lesser volume);
- Tanning baths and/or tanning substance (chromium or other) reuse/recycling;
- Retanning and fatliquoring in a same bath;
- Cleaner bath formulas – use of products that make possible shorter baths and/or cleaner final baths (lesser pollutant loads in the wastewaters);
- New processing vessels – new rotative drums, modified for shorter baths;
- Operations automation – improvement of process control;
- Recovery of condensed water vapor;
- Dry cleaning of installations and equipment (sweeping, scraping, gathering, exhausting, aspirating etc.) *BEFORE* water washings.

Each one of these general aspects and CP actions was checked in the tanneries regarding its situation: *'implemented'*, *'partially implemented'* or *'not-implemented'*.

3 Results and discussion

Considering the 9 (nine) visited tanneries and the 10 (ten) evaluated general water management aspects, there is a total of 90 (ninety) occurrences related to these aspects. The distribution which was verified for these items in the studied tanneries is showed in the Fig. 1.

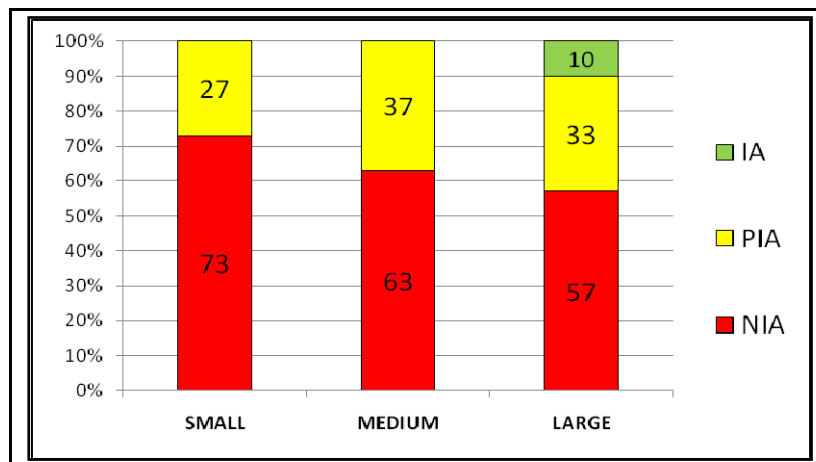


IA = implemented aspects; PIA = partially implemented aspects; NIA = not-implemented aspects

Fig. 1. Situation of the water management aspects for the group of studied tanneries (9 companies)

The survey presented only 3 occurrences (3% of the total – 90) for 'implemented aspects': the routine of water measurement in L2 and measurement for water and total wastewater in L3. The occurrences for 'partially implemented' and 'not-implemented' aspects totalized 87, which means 97% of the occurrences, with highlight for the 'not- implemented' ones (65%). *Therefore, it can be said that the water management still is incipient in these companies.* There are several opportunities for improvements in all of them, being positive the fact of that some water management aspects were 'partially implemented' (32% of the occurrences).

Fig. 2 shows the situation for each studied stratum.



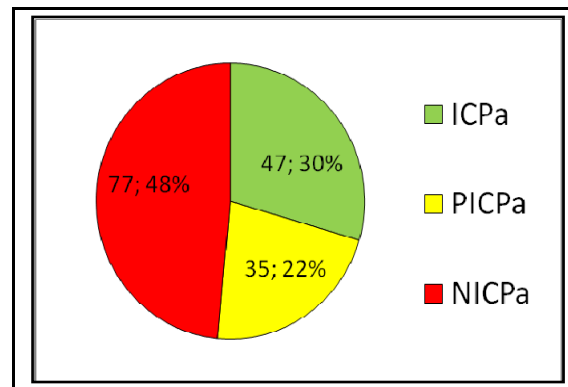
IA = implemented aspects; PIA = partially implemented aspects; NIA = not-implemented aspects

Fig. 2. Occurrence of the water management aspects in the studied strata of tanneries

Observing Fig. 2, there is a trend for 'improvement of water management' from the small to the medium and from these to the large tanneries. The percentages for 'not-implemented' aspects also decrease in this way: 73% for small, 63% for medium and 57% for large tanneries. As consequence, the percentages for 'partially implemented' and 'implemented' aspects resulted in 27%, 37% and 43% for small, medium and large tanneries, respectively.

Concerning the occurrence of the 19 (nineteen) CP actions which were checked in

the nine companies, Fig. 3 shows the situation for the total sample.

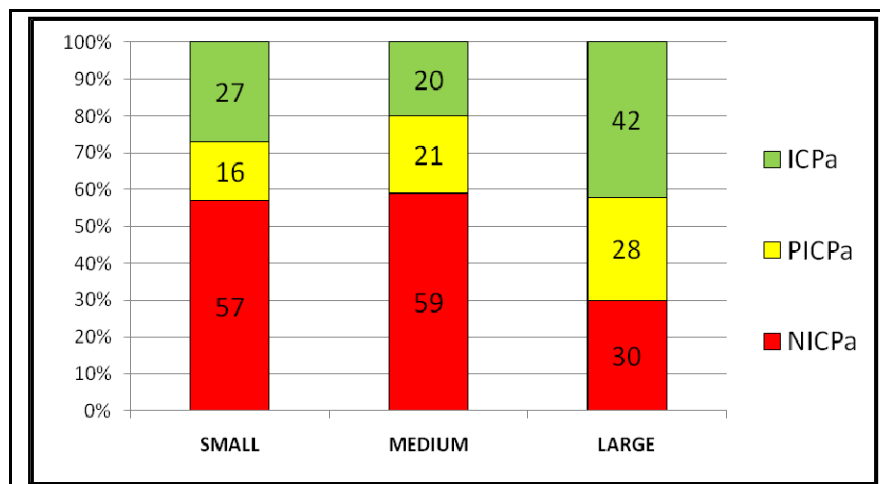


ICPa = implemented CP actions; PICPa = partially implemented CP actions; NICPa = not-implemented CP actions

Fig. 3. Situation of the CP actions related to the water use for the group of studied tanneries (9 companies)

This situation is more favorable than that showed in the Fig.1, related to the general aspects: 47 occurrences (30% of the possibilities) of CP actions were 'implemented' in the studied tanneries, although it was not consequence of a 'water management system'. Other operational needs and technical opportunities led to most of these CP actions, which have some positive impact on the rational use of water, being this a secondary consequence.

Fig. 4 illustrates the situation of the CP actions related to water use for each studied stratum.



ICPa = implemented CP actions; PICPa = partially implemented CP actions; NICPa = not-implemented CP actions

Fig. 4. Occurrence of the CP actions related to the water use in the studied strata of tanneries

For these CP actions, it can be verified that the 'small' stratum showed itself slightly better than the 'medium' stratum, with higher incidence of 'implemented' CP actions. In the same way of that for the general aspects of water management, the 'large' stratum presented the best performance, with the largest number of 'implemented' and 'partially implemented' CP actions. This behavior of results

seems to confirm that perception or trend of a better general performance for the 'large' stratum, probably due to a better structure in the larger companies, in terms of financial, technical and human resources, as well of some managerial practices.

The way used to present this diagnosis, showed in the figures 1 to 4, by utilizing the *traffic light colors* (red, yellow and green), results in a *'traffic light of water management under CP'*. This becomes a *measuring scale for water management* with a quick and clear view of its degree, a general status of this management. By applying this 'traffic light' periodically, it can be quickly seen the water management evolution, as well as the need of actions for its *continuous improvement* towards a certain established status which is put as goal or progressive degrees which are defined to be achieved.

With regard to the *inductive factors of the water management*, the more cited and effectively present factor in the searched tanneries – mainly among the 'small' and 'medium' ones – was *the total management cost of the wastewater, including that one related to the generated solid residues in the treatment plants*. Another pointed factor for some tanneries was *the limitation for launching of treated effluent (low assimilation capacity of the receiving water bodies and/or its large distance for launching)*. It is remarkable that other factors which could induce a water management system still are absent for the majority or totality of these tanneries – for example, limitation in water availability (only one tannery told scarcity events), the collection (taxes) for its use and the companies participation (and/or follow-up) in the activities carried through the local watersheds committees.

Concerning *the factors which make difficult the adoption of water management practices (the barriers)*, companies pointed: little employees awareness, low water cost, lack of suitable credit lines to the small and medium companies of the sector – for investments in cleaner technologies and automation, with lesser water consumption, low priority for the subject 'water' in the current business conjuncture, people resistance to changes of behaviors and procedures (at least initial), some necessary investments and some operational difficulties. Some of these barriers to the water management are similar to those for the general CP implementation.

Regarding the aspects of *integrated water management*, it was verified that the majority of the searched tanneries knows about its grant of water use, declares that it does not have knowledge on eventual local limitation for its water withdrawal, and that it does not have collection for the use of the water in its watersheds. S1, S3 and L1 declared to have local limitations for launching off their effluents, beyond the emission standards for the pollutants. However, except for M1, the searched tanneries do not participate nor receive regular information from the local watersheds committees.

With regard to the *CP actions related to the water use*, it can be highlighted: some skins washings carried out with closed or partially closed doors; salt beating before the process (soaking steps) – 3 occurrences in 6 possible ones; recycling of some baths (liming/unhairing – 5 occurrences in 8 possible ones and tanning – 5 occurrences in 9 possible ones). It deserves prominence the recycle or reuse of the final treated effluents by 2 companies among the 9 searched tanneries. In a certain way, this contributes to break a still strong paradigm in the sector of tanneries, about the 'impossibility of using final treated effluent in the productive process'. This is aligned with some works cited in the literature and in the references of this research, as much for the final treated effluents as for other process waters.

4 Conclusions

In a broad way, it can be concluded that *the water management under CP (or simply the water management) is not a routine practice in tanneries with beamhouse operations of Sao Paulo State. Its situation or degree is incipient.* The absence of some potentially inductive factors of this management, as the collection for the use of water and launching of effluents and the participation in the committees of watersheds, as well as some obstacles which were pointed by the tanneries, contribute to justify the lack of water management practices in these companies. On the other hand, these tanneries already have applied CP actions related to the rational use of water (conservation and reuse or recycling) and that is positive, even so these actions have not derived from a water management system.

In such a way, there are opportunities for improvements in the direction of implementing these management strategies in these companies, and the inductive factors, as well as the obstacles, which were pointed in this research, must be considered in the search of these improvements, together other eventual aspects which can be found in this way. The '*traffic light of water management*', on the basis of the developed reference in this work, can also be applied as a diagnosis tool of this management for other productive sectors, as much for groups of companies as for each productive unit.

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