THE REUSE OF TREATED WASTE IN AN OIL LUBRICANT PLANT

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ABSTRACT

The world has shown a troubling trend towards increased potable water consumption due to a growing population, the irrigation of agricultural areas and most especially through increased use within industrial processes. In the case of industrial processes the possibility exists to contribute to the development of sustainable management of water resources. Indeed, many companies are already taking steps to reuse water; the practical result of an overall program of water reuse by nominated environmental agencies in various parts of the world. The objective of this paper is to encourage the reuse of water in industry, through the release of a case study of water reuse by a lubricating oil manufacturer. Article consists essentially in the use of good quality water coming from the effluent treatment plants (physical-chemical).and biological treatment that was discarded in municipal sewage and is currently used as water for reuse in toilets factory lubricants. To ensure the quality of the water is chlorinated with sodium hypochlorite solution. The results achieved a cost reduction for the company and reduced the consumption of water resources. The cost to the company of potable water consumption was reduced by approximately 11,000 m^3/month (equivalent to an annual reduction payment of US $ 180,000), with the elimination of a fee for the sewer. However, it is important to make clear that this company paid all costs for the compulsory treatment of oily waste.

KEYWORDS: *Reuse, Water Treatment, Waste Treatment, Environment.*

I. INTRODUCTION

According to research, it is estimated that more than 70% of the surface of the earth is constituted of water. This includes over 97.5% salt water in the oceans and seas, 1.979% in glaciers, 0.590% in groundwater, 0.030% in rivers and lakes, and 0.001% in the atmosphere. Although the desalination process can be used to obtain fresh water, the cost is still very high. Although the most abundant water resources appear on the surface of the earth, fresh water is restricted to 2.5% of the total water existing on the planet, including not only surface but also groundwater that may be at depths of up to 4,000 meters, and glaciers. Thus, the percentage of freshwater that is easily accessible for human consumption is around 0.007%, lying in rivers, lakes and rainfall. Even so, for millennia water was considered an infinite resource [1-4].

This vision of an infinite good has been perpetuated throughout the history of man. According to Vernier [5] the beautiful satellite image of a blue planet can lead man to infer an abundance of water that can be seen to cover three quarters of the Earth's surface. However, water is needed in the right place at the right time. For example, water may serve the debt of a river in winter if it is almost dry in summer, or serve a great flood that destroys part of a country, or a lack of water may create a desert in another area, water may be lost through serving a large waterspout if it runs quickly to the sea.

It is possible to estimate that about one third of the population suffers from some type of terrestrial water scarcity. Most criteria of measurement are focused on the average per capita of water that is essential to satisfy the main human needs, taking into account the various factors that regulate interdisciplinary life in the various regions of the world. The Falkenmark indicator defines the index of water availability as the ratio of the renewable water resources considered constant over time, and population size. According to this criterion, it is considered that a country has a problem if water availability is between 1,000 and 2,000 m^3 per person/year. This category includes countries like the UK, India, Pakistan and Tanzania [1, 2].

Individuals use water for various purposes such as power generation and household needs, whilst in the public realm water is used mainly for industrial processes. Within the household water is used as a beverage, for cooking, personal hygiene, and irrigation of gardens; public use of water includes washing streets, supplying fountains and fire-fighting. Water is used in industrial processes as a raw material for the food industry, for cooling metallurgical and petroleum refineries, for washing in fabric and paper industries, and for the production of steam in the boilers of various industries [6, 7, 8].

In Brazil, water therefore became an economic good. Shortages were now seen as an opportunity to control the use of water using economic forces. The first step was the promulgation of the Law of Waters, No. 9.433/97 (01/08/1997) which charged a price for water that included only the cost of treatment and distribution [9, 10].

Although 30 years behind compared to the advanced countries, the Brazilian Water Law incorporates the most appropriate tools for management, having benefited from international experience in the management of water resources. The charge for the use of water resources, both for funding and for dilution of effluents, is a leading management tool created by this law, which perceives water as an economic good, and therefore a commodity with value.

Industries and cities that contaminate water through dumping large amounts of pollutants, such as disinfectants, detergents, solvents, toxic metals and oil in rivers and lakes, can contribute greatly to water conservation by using some form of sustainable management of water resources. Some companies are already taking steps to reuse water, which shows that it is possible to change behavior. The planned water reuse is part of an overall program spearheaded by the United Nations and the World Health Organization [11].

This paper focuses on a case study of the reuse of water in an oil lubricant plant, and the aim to reduce water consumption through the reuse of water originating from the physical-chemical and biological chlorination of water, reservoir storage and reuse in the administrative building toilets and factory in order to come into line with global concerns to reuse resources.

II. WATER REUSE

According to Braga et al. [12] types of water reuse can be explained using the following definitions:

- Indirect Reuse - occurs when the water is used one or more times within a domestic, industrial or commercial environment, and is discharged into surface waters or groundwater and used again downstream in a diluted form. Before the pickup point for the new user, it is subject to the actions of the natural hydrologic cycle.
- Direct Reuse - is the deliberate and planned use of treated wastewater for certain purposes such as irrigation, domestic, industrial or commercial use, aquifer recharge and potable water.
- Internal recycling - is the internal reuse of water in industrial plants before discharge to a general system of treatment or other disposal site that aims to save water and control pollution.

In their view the practice of reuse is a viable solution based on the increasing demand for water in the municipal, industrial or agricultural setting. Thus, the main benefits are the savings made from a reduction of water consumption and the wastewater generated, energy operating costs of equipment maintenance, and increased availability of water [13, 14, 15].

Additionally, the social responsibility of the company is highlighted through the reinforcement of the positive image gained by organizing and providing sustainable water management. However, it is important that the reuse of water for any intended purpose is subject to continuous critical monitoring and that strict standards of treatment and end use are established.

III. NON DRINKING WATER REUSE IN THE MANUFACTURE OF LUBRICATING OILS

The implementation of the use of reclaimed water from industrial processing occurred in a leading factory in the production of lubricating oils and greases for the automotive and industrial sector. The factory is located in Rio de Janeiro, Brazil.

The idea of reusing water is focused on the environmental sustainability philosophy practiced by the company where a properly implemented reuse policy has contributed effectively to the reduction of treated potability grade water used in industrial processes.

The effluent treatment plants (physical-chemical treatment and biological treatment) treat all wastewater from the manufacturing process which comprises essentially of water from the washing tanks, mixtures of lubricating oil, water from the containers, and mud and sludge from oily spills on the floors that flow directly into the channels.

Figures 1 and 2 shows the flowcharts of the wastewater treatment plants that treat oily water from the industrial process while the Figure 3 shows the oily waters from washing the containers.

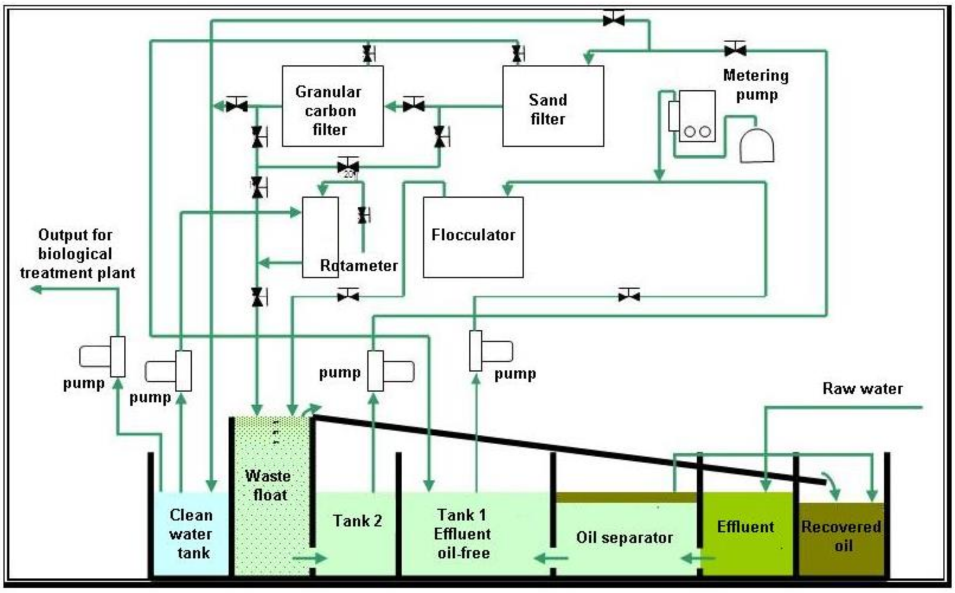

Figure 1 - Effluent treatment plants (physical-chemical).

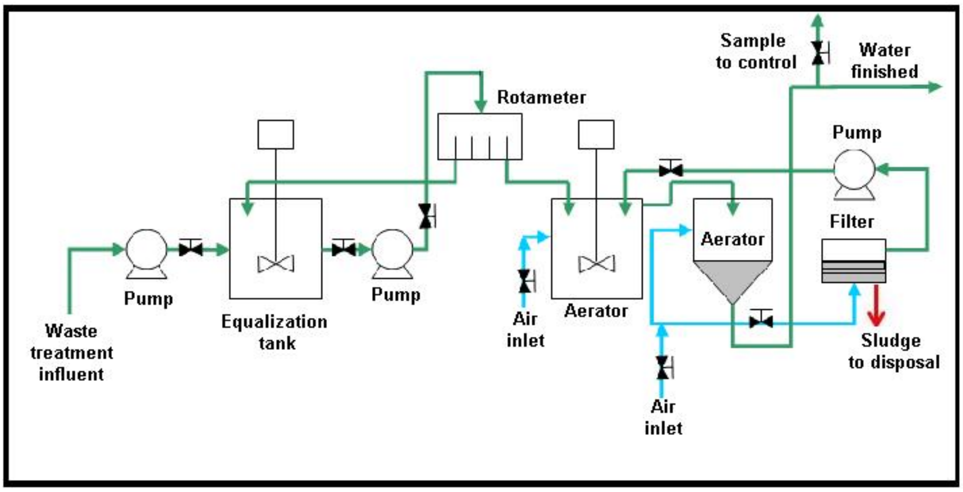

Figure 2 - Effluent treatment plants (biological treatment).

Figure 3 - Washing the containers.

All oily waste in the form of solids or paste from the sewage treatment effluent is sent to the disposable or reusable waste sector. This waste is packaged in drums for later final treatment in facilities outside the factory. Lubricants comply with the requirements and guidelines of environmental regulatory agencies. Figure 4 shows the drums labeled before being sent for this purpose.

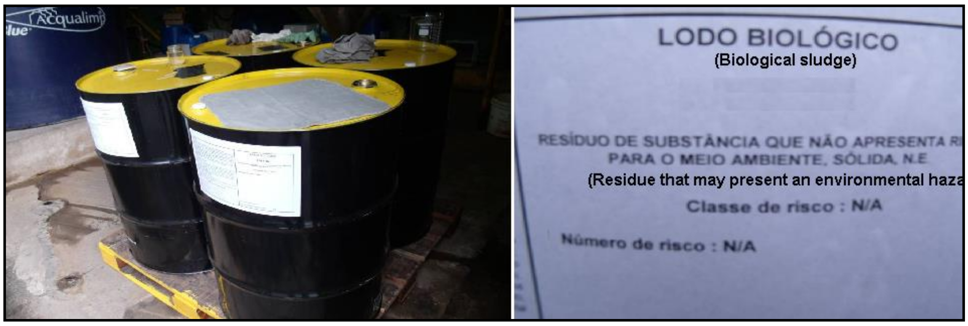

Figure 4 - Drums labeled to be sent for final treatment.

After treatment, water that complied with the conditions imposed by the Agency for Environment and Sanitation was released into the sewage network according to the procedures dictated by the local authority of the city of Rio de Janeiro. The volume of water released was on average 11,000 m^3.

The rate charged for drinking water supplied by the treatment plant is twice the volume considering launching the public sanitary sewer.

As shown in the flowchart in Figure 5, wastewater (according to Brazilian quality standards) resulting from treatment plants of industrial effluents and waters originating from the toilets was discarded directly into the municipal sewer.

The aim to establish a policy for reuse of wastewater in the lubricants plant was completed via a new project comprising the storage of the uptake of water from the treatment plants in a tank of 10,000 L, as shown by the flowchart in Figure 6, and the treatment of the stored water (Figure 7) with chlorine solution (sodium hypochlorite) pumped into four 2000 L tanks which continuously feed the toilets.

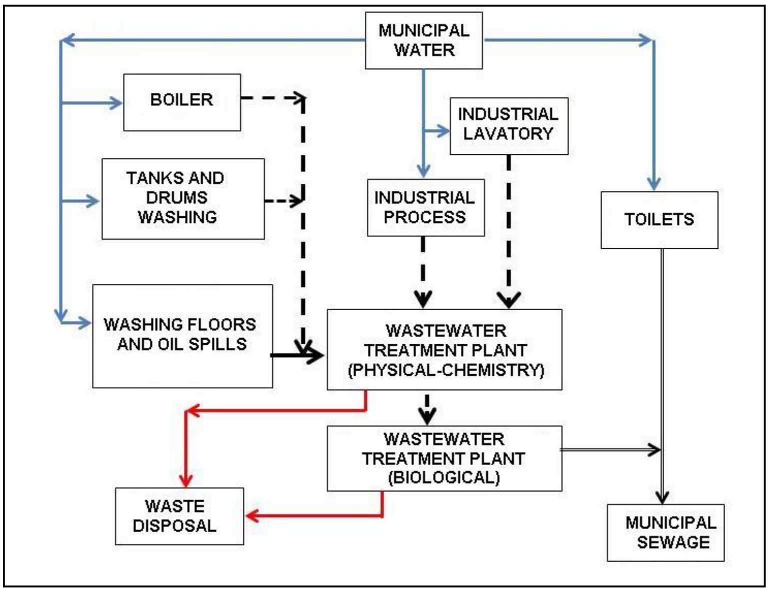

Figure 5 - Flowchart of the treatment and disposal of wastewater

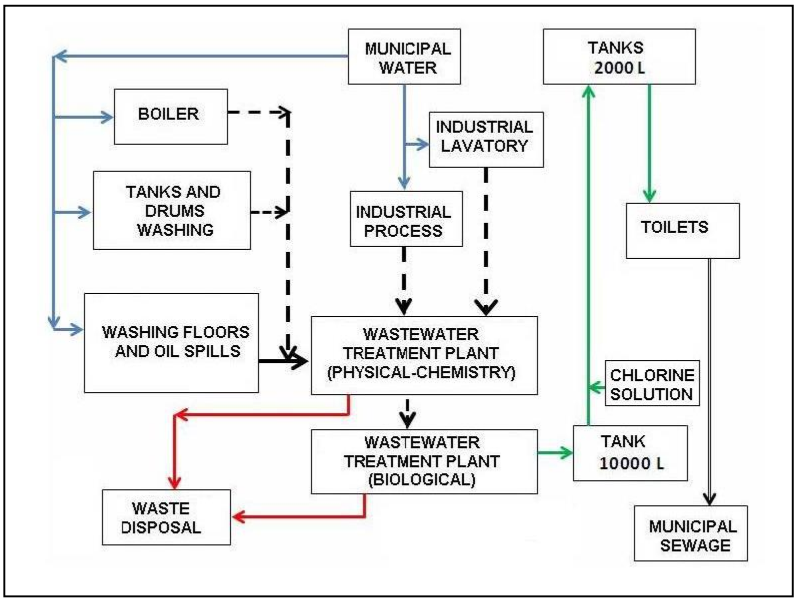

Figure 6 - System modification with reuse of wastewater for toilet

Figure 7 - Tank of 10,000 L and the treatment with sodium hypochlorite solution

Figure 8 shows the residual chlorinated water tank located on the roof of the factory which continuously feeds the toilets.

Figure 8 - Water tank located on the roof of the factory continuously feeding the toilets.

IV. Result and Discussion

Prior to 2010 all the water from the treatment plants (physical-chemical treatment and biological treatment) were drained into the municipal sewer. Since 2011 the water reuse originating from sewage treatment effluents were monitored through a hydrometer located at the output of 10,000 L tank (Figure 8). Based on the flowchart shown in Figure 6 the results of the volumes of reuse water used in toilets referring June to December 2011 resulted in a monthly average of 11,000 m^3.
In Brazil (Rio de Janeiro), the municipal laws shall establish and implement a tax on spending twice the volume of drinking water for the sewage drained into the municipal system. This means that when using the reuse of water for sanitary purposes, the company receives a bonus related to the water used in the toilets. Thus, the monthly average yields savings of $ 180,000 annually.
To ensure the safety of the system reuse water to the toilets is performed continuously injection of 0.5 ppm chlorine solution based on sodium hypochlorite (NaClO).

V. Conclusions

Based on this study and the implementation of a reuse project that uses good quality treated water from the treatment plants in the toilets of the plant it is concluded that:

- a reduction of potable water consumption in the order of 11,000 m^3 of drinking water equivalent to $ 180,000 could be achieved annually;
- another point worth mentioning are the studies conducted showing the possibility of the use of roofs for recovery of rainwater, although it is seasonal;
- the industrial sector has a high consumption of water; rational use of water resources with procedures such as the reuse of water is an inevitable way to contribute to better utilization of the available water on the planet.

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