Implementation of Evaporator to Minimize Wastewater Disposition

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Abstract

The medical device company currently has two areas in which the processes generate wastewater classified as Non-Hazardous. The current process involves expenses to subcontracted services for disposal, recurrent purchasing of containers and manpower dedicated to the collection, documentation and movement wastewater. The activity performed by associates during the process of collection and managing of wastewater, represent an opportunity related to ergonomics beside the environmental impact. The installation of a wastewater evaporator which will allow to reduce current amount of waste disposal, its related costs and will eliminate the ergonomic opportunity in associates that perform this task as well to reduce the environmental impact that this process cause.

Introduction

The medical device company as a part of its policy search to bring innovative solution to achieve competitive cost reduction and safe environment. This company generates several non-hazardous waste, mostly composed of water. As a solution to the current problem, the implementation of an evaporator was proposed to dispose of non-hazardous waste in the two areas of the plant that have more waste. Currently these areas generate an approximate of 18,000gal / yr. The goal is to be able to dispose of all the waste of the company which is 62,000 gal / yr.

Background

Different companies currently use evaporators to dispose their waste. For this reason the implementation of an evaporator has been the first option, and in accordance with federal local regulations including those promulgated by the Puerto Rico Environmental Quality Board (EQB), the Puerto Rico Aqueducts and Sewer Authority (PRASA) and the Federal Environmental Protection Agency (EPA) is the more viable option.
The equipment to be implemented has two options which are fill pump and auto fill system. The fill pump option is a simple evaporator which has a pump to place the water in the tank manually. The auto fill system includes the fill pump and has a system capable of automatically carrying water to the tank. It is important to know that the installation of either of the two equipment must have to be in an area that does not contain any type of fuel. These evaporators are prone to spills or accidents which will not be covered by the manufacturer's warranty. Also its important to know that the equipment has a useful life of approximately 10 years this will be depending on the use and maintenance .

Problem

The medical device company has processes that generate wastewater classified as Non-Hazardous. The current process involves expenses to subcontracted services for disposal, recurrent purchasing of containers and manpower dedicated to the collection, documentation and movement wastewater. The activity performed by associates during the process of collection and managing of wastewater, represent an opportunity related to ergonomics beside the environmental impact.

Methodology

This project uses DMAIC as logical steps that link tools and techniques sequentially and as a data-based strategy. During the process, a SIPOC was developed to map the current process in this way it is easier to identify the root cause of the problem since it provides us with a macro view of the process or product flow and its interrelations within the business.
In Figure 1 can observe in detail the SIPOC related to the process of disposal of waste in the plant. Basically two units are the ones impacted in this implementation which become the suppliers. As inputs we have the operator who is responsible for collecting waste and acquiring drums. The process involves a series of maintenance performed in each area of which non-hazardous waste is disposed. This waste will be placed in designated areas in the plant so that they are eventually collected by the external company in charge of their disposal which becomes our customers.

S	I	P	O	C
• Machine Center Unit • Microbiology Laboratory	• Drums container purchase • Storage Space • Operator	• PM execution • Place waste in containers • Take waste to satellite area	• Waste waters	• Company responsible for collecting and disposing the waste

Figure 1. SIPOC Diagram for the Wastewater Disposal

S	I	P	O	C
• Machine Center Unit • Microbiology Laboratory	• Drums container • Operator	• PM execution • Place waste in evaporator	• Slug solution	• Company responsible for collecting and disposing the waste (reduce the disposition in 90%)

Figure 2: SIPOC after Evaporator Installation

As much data as possible from the process was collected. The data of the year from both purchase and disposal of drones was reviewed. This is to be able to obtain the savings that must be obtained at the time of implementing the evaporator. This project involves a lot of documentation when implementing the evaporator. The first part consists in making a proposal at the managerial level which is tied to a capital investment. After the capital approval is carried out, management must be carried out to acquire the equipment. During the waiting period, work will begin with the regulatory environmental permits, permits relevant to the quality area and construction permits and equipment installation in the production area. An evaluation of the electrical system of the area must be done before proceeding to build. After the installation process, all types of documentation must be filled in order to place the equipment in our system. Reaching this point in the project could take about 4 months. In addition to the evaporator implementation, an equipment qualification must be carried out to be able to certify that the service it will provide is consistent and accurate. Therefore, prerequisites and parameters in which the evaporator must operate must be verified before executing. It must be ensured that the equipment fulfils the function established in a safe way, for this reason it must be installed according to the manufacturer's instructions and verify that it is consistent. To ensure that all of these needs are met, installation qualification (IQ), operational qualification (OQ) and performance qualification (PQ) will be performed.

Results and Discussion

Two equipment was proposed for the solution of the problem. Before proceeding to select an equipment, the water to be disposed was evaluated with an external company with an Full RCRA Analysis, since only non-hazardous waste is allowed. As a result of this evaluation, all the disposal can be evaporated since they do not contain any type of toxic substance. Additionally, a cost evaluation of both equipment was carried out taking into consideration the energy consumption, resources required and the payback period. The seconds option proposed was the ideal as it allows to dispose the waste automatically, which implies the elimination of purchase and disposal of drums and therefore the elimination of ergonomic risks. Due to the investment cost, the project must be divided into two phases where we will first be installing the evaporator to eventually move it to an automated process.

EQUIPMENT			
Evaporator	$ 8,995.00	$ 8,995.00
AFS (Auto Fill System)	-----	$ 1,895.00
Holding Tank	-----	$ 1,000.00
Valves, pipe, fitting, and miscellaneous materials	-----	$ 2,562.00
Equipment Cost	$ 8,995.00	$ 14,452.00
CONSTRUCTION		
Construction assumptions		
2 craft at $75/hr	-----	-----
weeks	3	6
5 days/week, 8 hours/day	-----	-----
Construction costs	$ 18,000.00	$ 36,000.00
Project Cost	**$ 26,995.00**	**$ 50,452.00**
OPERATION		
Energy cost ($/KWH)	0.2200000	0.2200000
Operation hours	4380	4380
Heating System (KWH)	27	27
Operation Costs	$ 26,017.20	$ 26,017.20

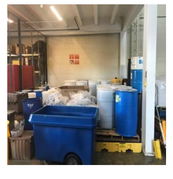
Figure 3:Cost evaluation of equipment, construction and electricity.

With the implementation of the first option the company would be saving an approximate $ 9K / yr with a payback of 2.83 years which will allow the second phase to be implemented in an approximate time of 3 years after the installation of the evaporator. In figure 4 can observe in more detail the saving

SAVINGS			
2018 Disposition			
15 gls capacity	Disposed drums	311	311
	Disposition Cost ($/drum)	20.25	20.25
55 gls capacity	Disposed drums	311	311
	Disposition Cost ($/drum)	35.25	35.25
Disposition Costs (DC) = 15 gals + 55 gals dispositions costs		$ 17,260.50	$ 17,260.50
Disposition Savings (DS) = DC x 0.9		$ 15,534.45	$ 15,534.45
2018 Raw Material Purchases			
	15 gls drums purchased	311	311
	15 gls drums costs ($/drum)	31.00	31.00
	55 gls drums purchased	311	311
	55 gls drums costs ($/drum)	55.92	55.92
Raw Material Costs (RMC)		$ 27,032.12	$ 27,032.12
Raw Material Savings = RMC x 0.9		-----	$ 24,328.91
Raw Material Savings (RMS)= RMC x 0.75		$ 20,274.09	-----
Savings = DS + RMS		$ 35,808.54	$ 39,863.36
Total Savings = Savings – O&M Costs		**$ 9,551.34**	**$ 13,366.16**
ROI CALCULATIONS			
Payback Period (years) = Project Cost/Total Savings		**2.83**	**3.77**

Figure 4: Cost saving analysis

Ideally, the equipment should be placed outside the plant since the construction cost would be reduced but the ergonomic factors would increase. For this reason, the equipment will be installed in Machine Center unit which implies in area preparation, electrical installations and other factors which will be evaluated along the way. This installation not only impacts the company's long-term savings, it also impacts the space through site, ergonomic and environmental factors. On the other hand, the company's space will be freed which will be useful for the production area. These areas can be seen in Figure 5-6. Currently hallways, stairs and satellite areas have been established in the company as a result of the high volume of waste disposal. As a result of the evaporator implementation all that space will be released.



Conclusions

The major contribution of this equipment to the company has been the reduction in expenses, risks in environmental and ergonomic factors inside the site and better use of space for the installation of other equipment for production. In addition to these contributions with this implementation, we reduce the responsibility of our company because when the process of disposal of waste with the subcontracted company is carried out if an accident occurs or is mishandled (which is not within our control) The responsibility remains with us. Basically, the transportation to dispose will be reduced by 90%, which is equivalent to less risks to our company. Everything will depend on the production. Then, from the implementation of the equipment it is estimated that the space released is 56 square feet, which will be used for the installation of more equipment. This is of great help since the company planned to rent external buildings to proceed with the installation of new equipment.
On the other hand, we must be aware that landfills are not a definitive solution, so all companies must be aware of this when disposing of their waste and taking measures to reduce the waste like the evaporator implementation.

Future Work

After the payback period is completed, the company will proceed to consider installing equipment automatization. This will lead to more savings since it involves the elimination of purchase and disposal of drums and the ergonomic and environmental factors will be eliminated. Additional will be evaluating the disposal of all waste generated in the plant which is estimated at 62,000gal /yr which implies an annual savings of $ 104K / yr. This also entails the release of more space, which is a great value to the company since we are currently implementing new products and process.

Acknowledgements

Jose A. Morales, Ph.D., PE Associate Professor,Design Project Advisor.

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