REDUCING COMPANY OPERATING EXPENSE USING LEAN SIGMA APPROACH BY IMPROVING WATER CONTENT IN OILY WASTE DISPOSAL

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Abstract

This project aimed to address the increasing Operating Expense (OPEX) of an oil company due to disposing oily waste. Company spent about $ 5.6 million to dispose its oily waste as side product of its operations. The goal of this project was to create a sustainable process that reduced the OPEX caused by disposing the oily waste. By applying Lean Sigma approach, the project team identified the current situation that the disposing oily waste practice was not done in efficient. Approximately about 41.7% water that should be in free of charge was contained in the oily waste that company paid. This was caused by lack of operator's knowledge, unavailable measurement device in the field as well as lack of Standard Operating Procedures. The project team also identified the optimal process to improve the water content. By the end of the project, project team had successfully improved the water content to 19.5% in average.

Keyword: Lean Sigma, Operating Expense (OPEX), Cost Saving

1. Introduction

CX is an oil company that is operated in Indonesia. In its operations, CX not only produce crude oil but also generated produced sand as side product. Oil and oily sand will be sent directly from the production wells to the Gathering Station. In Gathering Station, oil and oily sand will be separated. Oil will be processed so that it will contain Basic Sediment and Water (BS&W) less than 1%, while the oily sand will be collected and accumulated in the processing tanks. High content of oily in the oil will lead the processing tanks quickly filled. Eventually the sand will disturb the oil processing so that CX periodically has to drain the oily sand from the processing tank to designated pits. Pits should be also cleaned up periodically so that they can store oily sand for next drain process. As a company that upholds environmental stewardship, CX has an obligation to manage the oily sand waste. The handling of oily sand waste was conducted by third parties by injecting the oily sand waste back into the reservoir. For this service, CX had to pay for every barrel of injected oily sand waste. In addition to oily sand waste, CX also had other types of waste that was injected named oily viscous fluid (OVF) which was a by-product of oil processing at the Gathering Station caused by chemical emulsion.

2. Problem Formulation

Oily waste injection was one of Waste Management practice that had been used by CX to handle oily waste. The operation of oily waste injection was to mix oily waste with water to make slurry than it is injected to reservoir. CX paid the volume of oily waste meanwhile water as make up fluid was free of charge.

Picture below is oily waste injection simplified process.

Picture 1. Oily Waste Injection Simplified Process

Project Team conducted assessment to find out the most contributors for high cost of oily waste injection operations. Team found that the volume of OVF was the major contributor. After investigating, Team found that the water content in the OVF was still high, on the other hand the oily waste injection operation required make up water that was free of charge. Based on assessment result, Team focused how to improve the water content in OVF by utilizing Lean Sigma approach.

3. Conceptual Framework

Lean sigma approach is a methodology for improving the performance. Lean is a management philosophy derived mostly from the Toyota Production System (TPS)[2]. Lean focus on eliminating waste from the process with waste being defined as anything that is not necessary to produce the product of service. The six sigma philosophy maintains that reducing variance will help solve process and business problem. Six sigma involves the steps that focus on voice of customer, process map, and key business indicator. Six sigma consists of Define, Measure, Analyze, Improve, and Control (DMAIC) methodology.

Define process is to describe the problem and its impact to business performance. During this process, key characteristics that are important to customer and the processes are identified along with existing output condition and process element. The next process is to focus on measuring the process at issue. During this step, key characteristic are categorized, measurement system are verified, and data are collected. Once data are collected, data are analyzed in the six sigma model. The intent is to generate information of the problems. These are including identifying the fundamental and most important causes of defect and/or variability of the process.

At improve process, potential solutions to process problem are identified and implemented. The results of the process changes are measured and adjustments are made as necessary. If the process is found to be performing at a desired and predictable level, it is put under control process. This process is a maintenance process of six sigma methodology. The process is then monitored to assure that no unexpected changes occur.

Lean sigma basically is a combination between Lean and six sigma that focus on improving process by improving quality, reducing waste and inventory.

4. Methodology

4.1. Define

As describe in the problem formulation, CX Management wanted to reduce the OPEX related to the oily waste injection operation. Project team saw that cost of oily waste injection was purely contributed by volume of oily waste being injected. Project Team started identifying the factors that contributed to the oily waste volume.

4.2. Measure

A data collection was done in both waste source and in the oily waste injection storage system which was in the tank and the storage pit. During the assessment, Project Team conducted daily sampling from both waste source and the oily waste storage system. So in total project team had collected about 90 samples per month. The sampling was done for 10 months for baseline data. The average water content for 10 months sampling was 41.7%.

Project Team also focused in assessing the process flow of waste handling starting from loading waste in the waste source until storing waste in the oily waste injection facility. The process flow can be seen in the figure 2. Based on process flow, there were two processes that had direct impact to water content, load waste and store waste.
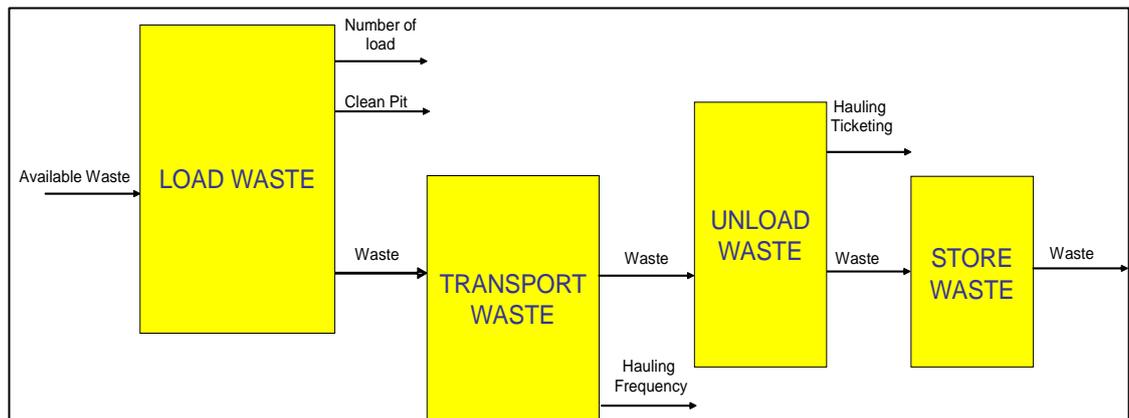

Figure 2. Initial Process Flow

4.3. Analyze

A cause and Effect Diagram then was developed to analyze the variables that have significant effect to water content. Project Team selected variable as C for constants (variables that remain constant and have no effect on the water content) and N for noise (variables that often fluctuate and have effect on the water content). Some of the significant noise variables were identified, such as:

- dewatering system/procedure,
- waste selection,
- settling time,
- operator procedure,
- number of heavy equipment,
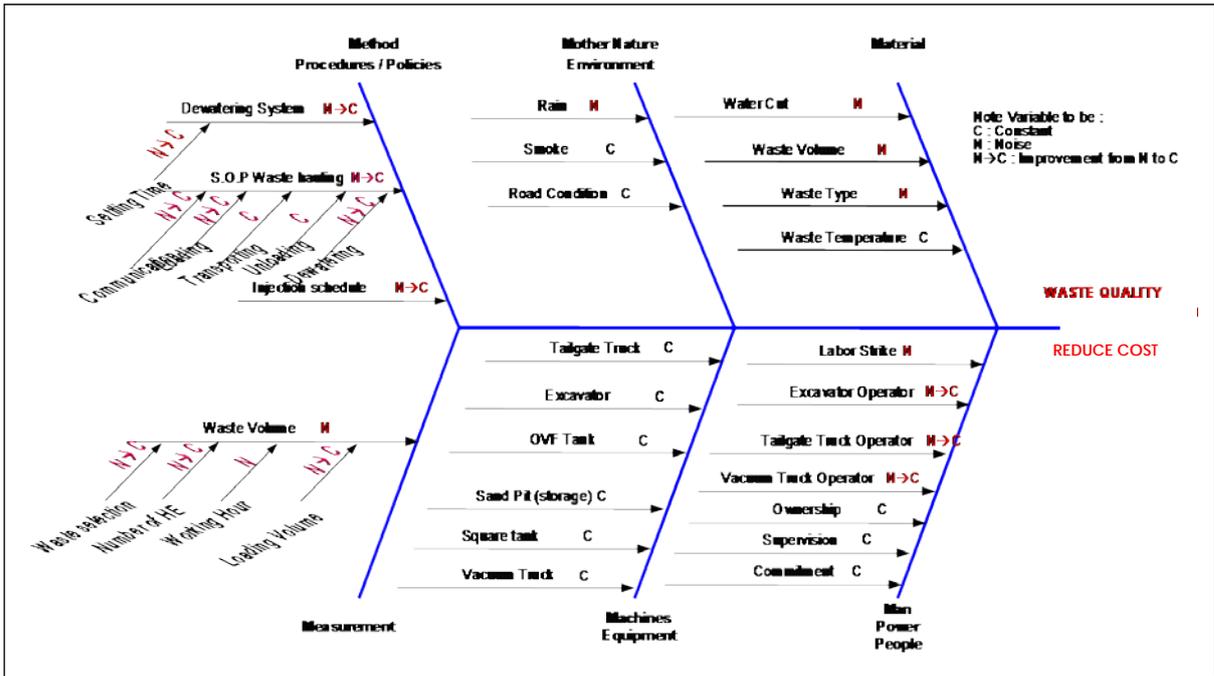- communication,
- injection schedule.

Figure 3. Cause and Effect/Fishbone Diagram

4.4. Improve

The current process allowed huge volume of oily waste transporting to the oily waste injection facility. Improvement was made by developing new process flow. Project Team added a step prior load waste by selecting oily waste to be hauled. Inspection and scheduling were important tasks to do prior cleaning up the waste pit. Dewatering process also added in the storing process to ensure water content meet the specification of maximum 25%.

Cause and effect diagram showed some noises that needed to be handled to make them constant parameters. New Standard Operating Procedures/SOPs were developed to ensure all noise parameters could be changed as constant parameters.
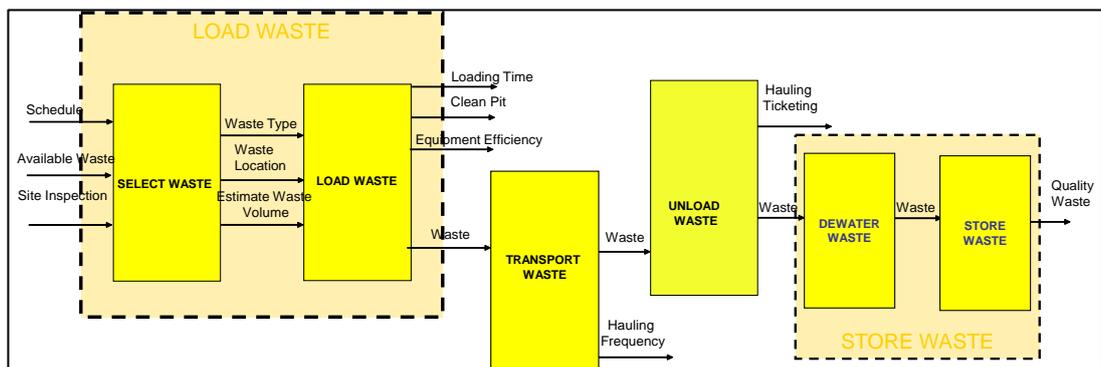

Figure 4. Improved Simplified Process Flow

4.5. Control

A run chart was used to record and display trends in the process performance metrics over time. Project Team used this tool to detect meaningful changes it made to the process. Results of the waste quality improvement can be seen by reducing water content in the figure 5. Project Team monitored the performance for 12 months to ensure the sustainability of the process improvement.
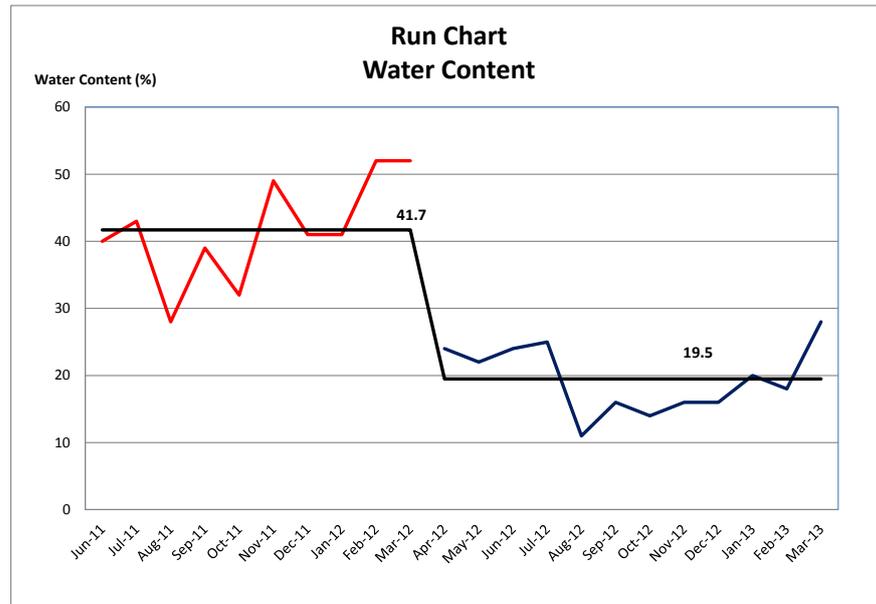
Figure 5. Run Chart Water Content

From figure 5 above, it looks that there was a significant difference of average water content between pre-improvement and post-improvement. The average water content decreased from 41.7% to 19.5%. Team used "t Test Analysis (Mean)" and "F Test Analysis (Std Dev)"to determine if statistical difference exist in mean and standard deviation.

t Test Analysis (Mean)

P-value = 0.000004405

F Test Analysis (Std Dev)

P-value = 0.069

Based on test result, P-value in "t Test" is less than 0.05 showing that there is a significant mean difference between pre-improvement and post-improvement. In "F Test", P value is higher than 0.05 showing that there is no a significant standard deviation difference. It is happened since there were some factor that effected to water content had not been focused such as rain water and water cut in the waste generated (see in figure 3 Cause and Effect Diagram). Decreasing water content has impacted to decreasing waste volume injected to Oily Waste Injection Facility. The waste volume trend can be seen in figure 6.
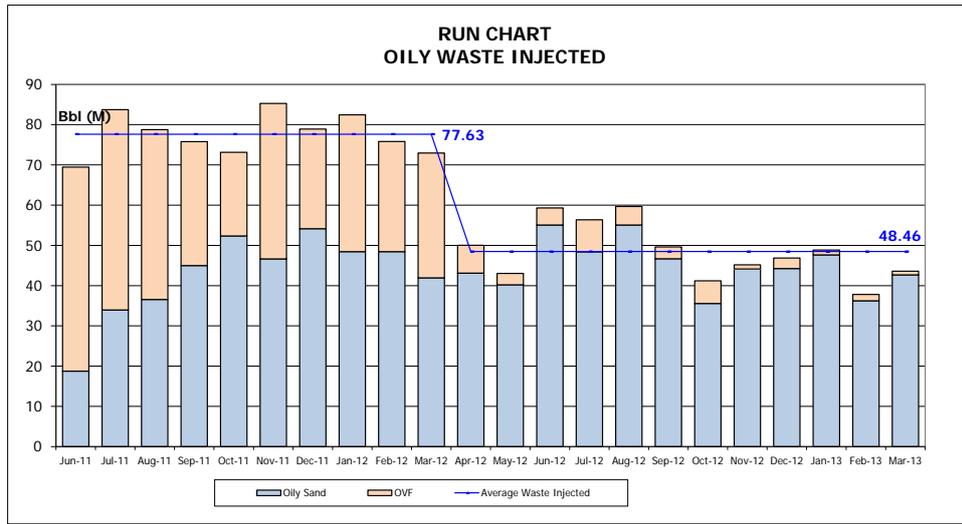
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Figure 6. Run Chart Oily Waste Injected

5. Solution

Project Team did some changes to the process and the procedures. Flow Process was changed to ensure that the process could run effectively. The Process Flow Diagram explained series of activities starting from selecting waste until waste ready to be injected. Procedures/SOPs were rewritten to ensure the consistency of operator performing the tasks.

Before cleaning up the oily waste in the waste source, operator must conduct an assessment to ensure that waste condition was thick enough and sand volume had been accumulated in the pit. Operator would decide which pit to be clean up. Heavy equipment operator must follow the SOP that he had to ensure only thick waste and sand to be excavated to the dump truck. In the oily waste facility, operator was responsible to conduct sampling in the sand pit. If the water content more than 25%, he had to call vacuum truck to suck the water and move it to the OVF tank. Settling process was required in the tank so that there will be physical separation between oil and water. After minimum 4 hour, operator had to drain the tank until oil detected. After then sampling to the OVF was done through the several sampling point to ensure the water content of maximum 25% achieved.

After water content condition of maximum 25% achieved in both sand pit and OVF tank, oily waste can be injected to reservoir.
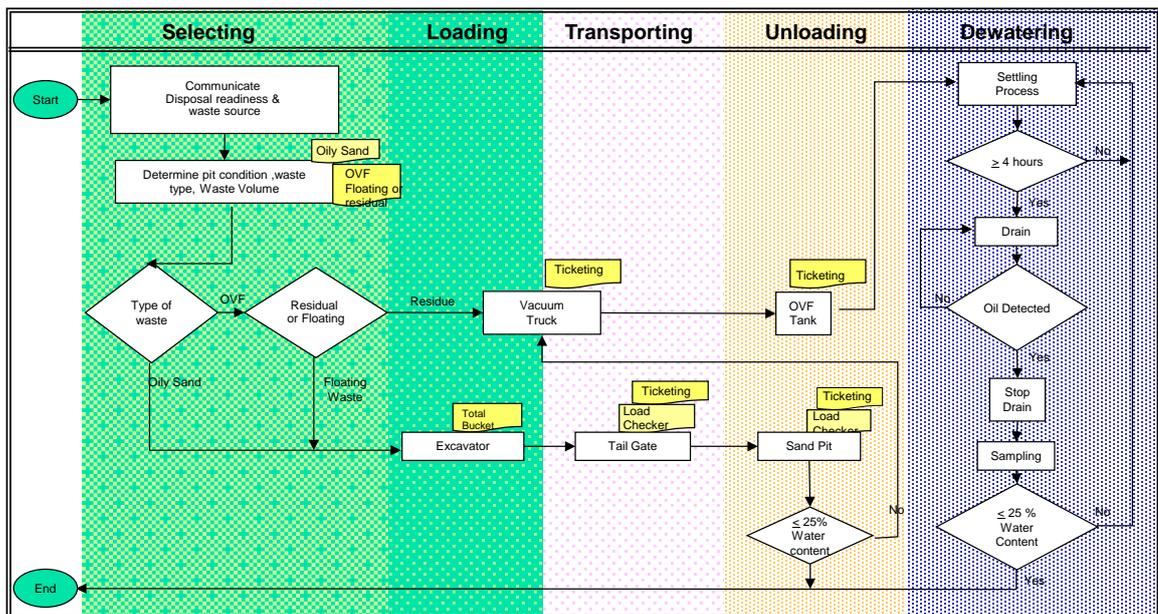

Figure 7. Proposed flow chart

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6. Conclusion & Recommendation

The overall goal of this project was to reduce OPEX related to the oily waste injection operation. As Lean sigma can be applied in every process improvement, the Lean Sigma methodology was used by Project Team. Project Team must focus on process that was critical, simplest, easiest solutions, and had highest impact to the process performance. After defining the problem, it was clear which performance measures needed to be studied. From this data, improvement opportunities were analyzed and action plans were created to help implement those plans. Finally a standardized method was developed in order to ensure the process would be sustainable. In this case, Project Team could reduce the water content from 47.1% in average to 19.5%. Reducing the water content eventually reduced the volume of oily waste injected from 77,630 barrel/month in average to 48,460 barrel/month. This effort had successfully reduced the OPEX about $ 2.1 million per year.

To ensure the sustainability of improvement, commitment form operation leadership and operator must be maintained. Operator leadership had to conduct routine inspection to the field to ensure the new processes and procedures were implemented consistently. Communication among teams is also a critical part of the operation that every morning tailgate meeting is a tool that can be utilized.

7. Reference

1. Gupta, Praven (2004), *"Six Sigma Business Scorecard: Creating a Comprehensive Corporate Performance Measurement System"*, McGraw-Hill
2. Pojasek, Robert B (2003), *"Lean, Six Sigma, and The System Approach: Management Initiatives for Process Improvement"*, Environmental Quality Management
3. http://en.wikipedia.org/wiki/DMAIC
4. http://www.dmaictools.com/