

INCREASING RELIABILITY OF CHEMICAL PUMPS PACKAGE BY USING SS316L IN OIL PRODUCTION WELLS

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ABSTRACT

The reliability of production facilities in the oil and gas industry greatly affects the resilience of production. To maintain the reliability of production facilities, it is necessary to carry out preventive maintenance (PM), corrective maintenance (CM), risk base inspection (RBI) and reliability center maintenance (RCM) programs. On this occasion, the author raised the problem of RBI on the chemical pump skid in the oil production well which decreased reliability due to corrosion. Chemicals injected into the pipeline are acidic, where the liquid serves to prevent calcium carbonate (CaCO₃) scale formation in the pipe. The skid and liquid reservoir are made by carbon steel, resulting in frequent leaks in the tub and the skid is not sturdy enough to support the load. With the use of SS316L material for the tank and pump skid, the damage caused by corrosion can be overcome so that the reliability of the chemical pump can be maintained.

Keywords: Reliability, Corrosion, SS316, Calcium Carbonate

1 INTRODUCTION

Most of the oil production wells need to be installed with chemical pumps. This chemical pump functions as a chemical distribution tool whose job is to control the hydrocarbon liquid so that it can flow smoothly to its destination. The impact that will occur if not controlled can result in Lost Production Opportunity (LPO) due to blockage of the distribution pipe and can also damage the company's image if there is a leak in the distribution pipe.

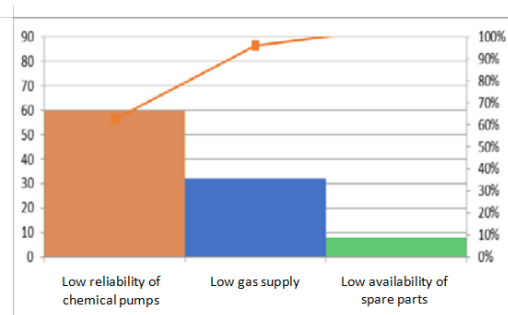


Figure 1. Identification of problems in the chemical pump

The results of the identification of problem with chemical pumps are the low reliability of the pump.

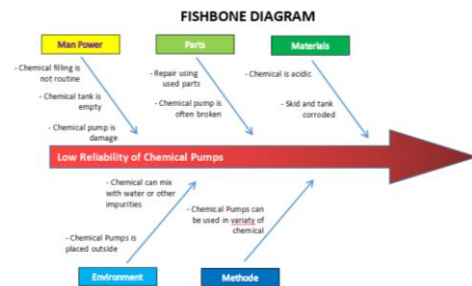


Figure 2. Fish Bone Diagram

No	Root factor Reason	Analysis / Description Cause and effect	Results Field test	Correlation (Yes/No)
1	Man	Chemical filling not a routine	There are operators at each collecting station, but their responsibilities include all production facilities.	No
2	Tool	Use of used spare parts to repair chemical pumps	The use of used spare parts becomes ineffective due to its durability and lifetime to be short because the conditions are not perfect anymore	Yes
3	Ingredient	The material used in the skid and the Most Social Chemical Pump Tank	Based on the results of the sample it is known that the tank and skid material can not stand the chemical characteristics that are injected	Yes
4	Method	The unavailability of standard types of chemical pump material set materials compared to the type of chemical used	Several studies have been conducted to see the correlation between material and chemical	Yes
5	Environment	Chemical pump is placed outdoor	With the condition of the chemical pump being outdoor, the possibility of chemicals mixed with other impurities greater	No

Tabel 1. Correlation Analysis

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	Root cause / cause	Impact / effect	S	O	D	RPN	% Cumulative
A	The material used in the skid and the Most Social Chemical Pump Tank	Skid and Chemical Pump Tank Leaking	5	5	5	80	83.3%
B	Use of used spare parts to repair chemical pumps	Chemical pumps often stuck	3	2	2	12	95.8%
C	The unavailability of standard types of chemical pump material set materials compared to the type of chemical used	Purchase pumps and accessories never stand the type of chemical used	1	2	2	4	100.0%

Tabel 2 Pareto Dominant Cause

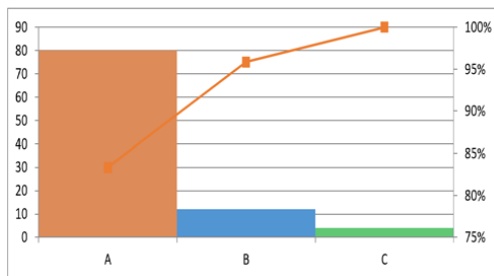


Figure 3 Pareto Dominant Cause

Based on Pareto, the dominant cause can be seen that the skid material used is corroded by the chemical being treated so that often the pump cannot function properly.

2 LITERATURE STUDY

2.1 Corrosion

Corrosion is the process of decreasing the reliability of metals due to chemical reactions in their environment. There are two differences in the process of corrosion, namely wet corrosion and dry corrosion. The corrosion occurs due to chemical, thermodynamic, metallurgical and electrochemical factors. There are 8 classes of corrosion, namely well corrosion, crevice corrosion, galvanic corrosion, grain boundary corrosion, erosion corrosion, selective corrosion, stress corrosion and selective corrosion. In everyday life corrosion is known as iron rust.[1]

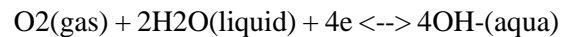
Corrosion occurs because the metal is oxidized, while oxygen (air) is reduced. Red-brown metal rust in the form of solid oxides or carbonates.

The Chemical formula for iron rust is $Fe_2O_3 \cdot nH_2O$,

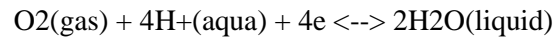
The electrochemical process in certain parts of the corrosion of iron acts as the anode, where the iron is oxidized.



The electrons liberated at the anode flow to another part of the iron which acts as the cathode, where oxygen is reduced.



or



The iron(II) ion formed at the anode is further oxidized to form iron(III) ion which then forms a hydrated oxide compound, namely iron rust. To find out which part of the iron acts as the anode and cathode, it depends on various factors, including differences in the density of the metal or impurities.

Corrosion will damage the metal electrochemically or also called chemically, which is the reverse process of extracting metal from the mineral ore. It can be seen that iron ore in the wild exists in the form of iron oxide compounds or also iron sulfide, after going through extraction and processing to produce iron for use in the manufacture of steel or alloy steel. During use, if rust protection is not carried out, the steel will experience a reaction with the environment that causes corrosion, namely returning to iron oxide compounds

To determine the possibility of corrosion, you can use the Voltaic Series and Nernst's Equation Law. Corrosion speed can be controlled, including by placing an oxide layer because the oxide layer can block the potential difference to other electrodes which will be very different.

2.2 Stainless Steel

Stainless Steel is a stainless steel that contains as much as 12% Chromium, it is formed on the surface of the iron so that there is no oxidation of Ferum (Fe) [2]

SS316 is a chromium-nickel steel including molybdenum. Klik atau ketuk di sini untuk memasukkan teks. SS316 and SS304 are types of steel have many similarities but SS316 is better than SS304. The molybdenum in SS316 is more resistant to pitting and crevice corrosion in chloride environments.

SS316L is a type of low carbon steel that has better corrosion resistance, which is equipped with resistance to intergranular corrosion in welding.

SS316H is a kind of high carbon steel. This type of steel is more suitable for applications at high temperatures.

SS316Ti is a carbon steel added with Titanium. Almost the same as SS316H, SS316Ti is resistant to corrosion, and is more suitable to be applied at high temperatures, but the ability to corrode is further improved, especially for formic, acetate, chloride sulfate.

3 METHODOLOGY

3.1 Design

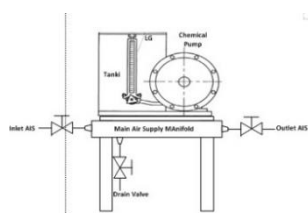


Figure 4 Pump Design

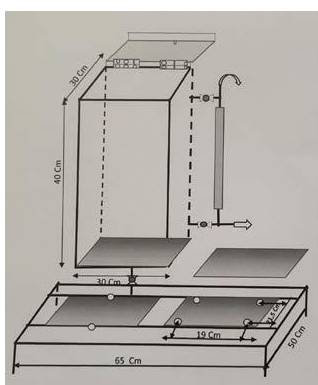


Figure 5 Tank Design

3.2 Procedure

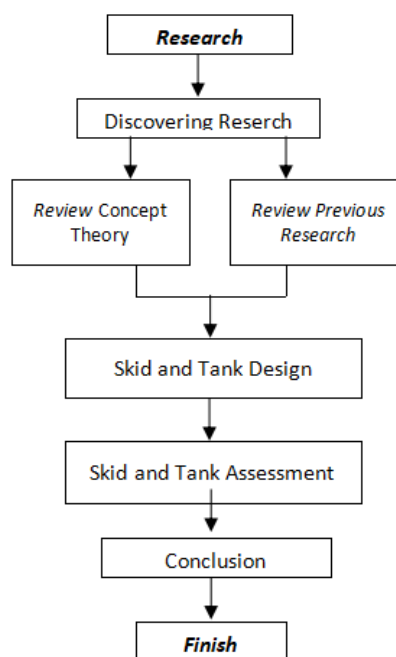


Figure 6 Process Flow Diagram

3.3 Data Process

Fabrication planning will go through several considerations including cost, duration, implementation impact, risk, fabrication and material availability. This is a consideration for determining the executor of the work.

NO	Requirements	Procurement of skid and new tanks	Skin repair and existing tanks	Making Tank skid
1	Estimated costs	50 million	1 million	5.5 million
2	Job duration	24 weeks	2 weeks	2 weeks
3	Work impact on disruption of oil and gas production	During installation	During installation	During installation
4	risk	Low	High	Low
5	Fabrication & Construction	Third party	Self-subsistent	Self-subsistent
6	Material needs	New	Used	Used
Conclusion		Not Selected	Not Selected	Selected

Tabel 3 Job Determination Table

For the successful implementation of the work through consideration of 5W + 1H, namely Why, What, When, Who, Where and How. The implementation of 5W+2H aims to ensure that the work can be carried out properly so that the target can be achieved. [What Is a 5W2H Analysis? \(And How To Use One Effectively\)](#)

Why	How	What	When	Who	Where	How Much	Target	
Pembuatan Skidrang	Preparation	Skidrang Survey, design and drawing	1 Januari 2021	Michael, Husin, Taufik	RAM Office	Man Hours 1 Days x 3 Person	Trend for requesting repairing chemical pumps leaked after applying	
	iMac Making	Submit iMac according to the design	1 Januari 2021	Regy	HSSE Office	Man Hours 1 Days x 1 Person		
	Procurement							
	Procurement of materials and services	Making memo, collecting plate materials, pipes and used flanges, as well as new material reservations	2-9 Januari 2021	Michael	RAM Office	Man Hours 7 Days x 1 Person, 5,5 million		
	Construction							
	Fabrication	Build skidrang according to design	9-23 Januari 2021	Regy, Husin, Taufik	Workshop RAM	Man Hours 14 Days x 3 Person		
	Installation	Arranging Skidrang with a Chemical Pump	24-25 Januari 2021	Husin, Taufik	ABAB II	Man Hours 2 Days x 2 Person		
	Commissioning							
	Commissioning	Test the operational capability of the Chemical Pump Set with Skidrang	25-31 Januari 2021	Husin, Taufik	ABAB II	Man Hours 6 Days x 2 Person		
	Monitoring							
Monitoring	Observe performance	February 2021	Michael, Regy	ABAB II	Man Hours 30 Days x 2 Person			

Tabel 4. 5W + 2H

The implementation of the work must have Value Creation which can be viewed from Quality, Cost, Delivery, Safety and Moral. [M08. Aspek Panca Mutu | PDF - Scribd](#)

Panca Quality	Impact of Issue / Initial Problem	Initial repair target
Quality	Chemical injection processes are disrupted due to chemical pumps frequently down	The chemical injection process is uninterrupted and continuous
Cost	The frequency of purchasing high chemical pump spare parts	The frequency of purchasing chemical pump spare parts drops 50%
Delivery	It takes a chemical injection downtime time for an average of 3 hours longer for chemical pump repair	Downtime is reduced due to reduced frequency improvements
HSSE	Chemical spills occur around a well that can absorb to the ground	Chemical has no scattered because the tank is in good condition
Moral	Becomes a burden for workers for repeated repair of chemical pumps	Repeated improvements can be minimized

Tabel 5 Panca Mutu

The implementation of the work is expected to be completed within 2 months so that the benefits can be immediately felt for increasing the reliability of the chemical pump

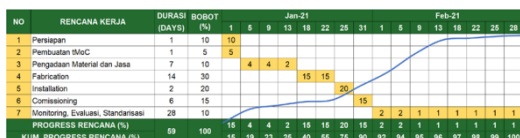


Figure 7 Timeline

4 RESULTS AND DISCUSSIONS

The results of research and application can be measured as follows.



Figure 8 Timeline achievement

How Rencana	Realisasi	When	Who	Where	Hasil (Gambar, Bukti, Dokumen, dll)	How Much	Gap Finding	Gap Solving
Engineering								
Persiapan	Survey, desain, dan drawing Skid Tang	1 Januari 2021	Michael, Husein, Taufik	Kantor RAM		Man hours 1 days x 3 persons	As plan	
Pembuatan IMoC	Mengajukan IMoC sesuai dengan desain yang akan dipaparkan	1 Januari 2021	Regy	Kantor HSSE		Man hours 1 day x 1 persons	As plan	
Procurement								
Pengadaan Material dan Jasa	Membuat Memo, mengumpulkan material plat, pipa, dan flange bekas, serta reservasi material baru	2-9 Januari 2021	Michael	Kantor RAM		Man hours 7 days x 1 persons, 5,5 juta	As plan	
Construction								
Fabrication	Membangun Skid tang sesuai desain	9-23 Januari 2021	Regy, Husein, Taufik	Workshop RAM		Man hours 14 days x 3 persons	As plan	
Installation	Merangkai Skid tang dengan Pompa Chemical	24-25 Januari 2021	Husein, Taufik	Abab II		Man hours 2 days x 2 persons	As plan	
Comissioning								
Comissioning	Menguji kemampuan operasional set pompa chemical dengan skid tang	25-31 Januari 2021	Husein, Taufik	Abab II		Man hours 6 days x 2 persons	As plan	
Monitoring								
Monitoring	Mengamati performa	Februari 2021	Regy, Michael	Abab II		Man hours 30 days x 2 persons	As plan	

Tabel 9 5W+2H achievement

Panca Quality	Initial repair target	The results of the final improvement	Conclusion
Quality	The chemical injection process is uninterrupted and sustainable	Chemical injection process to be sustainable	Over the target
Cost	The frequency of purchasing chemical pump spare parts	Frequency of Purchasing Chemical Pump Spare Parts 60%	Over the target
Delivery	Downtime is reduced due to reduced repair frequency	Chemical injection downtime drops from an average of 3 hours to 1 hour	Over the target
HSSE	Chemical has no scattered because the tank is in good condition	Chemical has no scattered because the tank is in good condition	Over the target
Moral	Repeated improvements can be minimized	Repeated improvements can be minimized	Over the target

Tabel 7 Panca Mutu achievement

Root cause / cause	Impact / effect	S	O	D	RPN	% Cumulative
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Tabel 8 Pareto Table

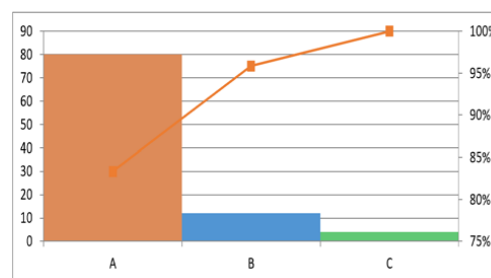


Figure 9 Pareto before

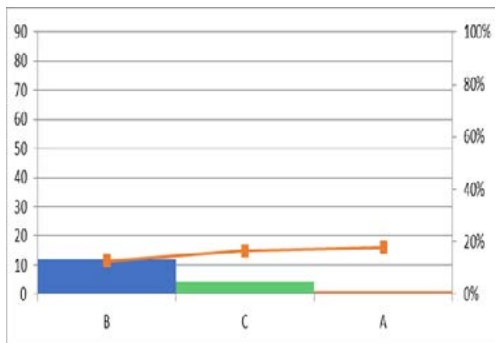


Figure 10 Pareto After



Figure 10 Trend Workorder Before and After Repair

5 CONCLUSIONS

Increasing the reliability of Chemical Pumps in Production Wells can be done after going through the right research and methodologies so that they can correctly solve the problems. This can be measured from the number of Workorder to maintenance can be reduced significantly. The use of SS316L material on Skids and Tanks is the right choice for corrosive liquids

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- [1] B. Praktis Korosi, "GADANG PRIYOTOMO," 2015. [Online]. Available: www.nulisbuku.com
- [2] T. Gde Tirta, "Diktat Material dan Proses STAINLESS STEEL."