DISCOVERY

Reliability analysis of mobile air compressor component of air hose

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ABSTRACT

The air hose failure as a component of Mobile Air Compressor (MAC) was monitored in the operation of Obrikom gas plant for a period of four years and downtime, mean time between failure, failure rate, reliability, unreliability and availability values were evaluated in this investigation. The air hose as a component in the mobile air compressor plays a major role in the day- to – day operation of gas plant facility. The downtime increases from 68hrs to 79hrs for period of four years sampling with 68hrs for first year sampling, 72hrs for second year sampling, 75hrs for third year and 79hrs for fourth year sampling. The mean time between failures was evaluated for each of sampling period and the following results were obtained as 496hrs, 397.7hrs, 324hrs and 235.2hrs for the period of four years sampling and the failure rate values were 0.000684, 0.000799, 0.000913 and 0.00114. The investigation demonstrates decrease in the mean time between failure and increase in the failure rate as well as the reliability of air hose mobile air compressor decreases with increase in sampling time of the year as the cost of unreliability increases as the year of sampling increases. This investigation addresses the usefulness of air hose component in mobile air compressor and the need for continuous monitoring for the purpose of preventive maintenance as well as increase production.

Keywords: Reliability, analysis, mobile air compressor, component, air hose

1. INTRODUCTION

The air obtained from compressor is essential to exploration as well as production industries, thus there is need to ensure regular maintenance of the equipment required to deliver the compressed air to avoid breakdown on site (Abels and Kissock, 2011; Addala and Gangada, 2013). Mobile air compressed systems are very popular and widely used in industrial facilities. They are used for providing compressed air to the systems, such as machines, pneumatics, tools and transportation (Smaili and Diab, 2007). Mobile air compressor component performance parameter such as reliability, availability, maintainability and safety ought to be built in during the design phase and will be sustained during the operation of the equipment or system (Barabady and Kumar, 2008; Barabady, 2005; Beals et al., 2003).

If the system and components fail for a longer time or the frequency of the failure is high, this will surely cause a total production loss and the company

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would lose more than million dollars per day. In other to avoid this situation to occur, a reliability study needs to be done onto the system and its components (Benedetti et al., 2017; Bhakta et al., 2012; Birolini, 2014). The important of these compressors are always considered during production, because of their significance in the operation and it was observed that failure of the compressor may result to total shut down of the process plant (Brown et al., 2022).

Therefore, test for the reliability of the compressors are necessary and this approach will enhance productivity of the process plant (Dekker, 2006). As a result of this, the researcher sees the subject matter of investigating the performance of mobile air compressor component of air hose as an empirical problem worthy of attention (Abels and Kissock, 2011; Addala and Gangada, 2013; Smaili and Diab, 2007; Barabady and Kumar, 2008; Barabady, 2005; Beals et al., 2003; Benedetti et al., 2017; Bhakta et al., 2012; Birolini, 2014; Brown et al., 2022; Dekker, 2006).

Hence, the researcher intends to study the mobile air compressor and aim to examine performance of the mobile air hose component using reliability analysis for facility performance system (Digilis et al., 2007; Dindorf, 2012; Durovic and Kovadevic, 2004; Godwin et al., 2020), the efficiency and integrity of its facilities, cut down equipment failure and the cost-effective methods for the facilities performance was considered in this investigation.

2. MATERIALS AND METHOD

Materials

Material data sheet was obtained from the operation unit for this investigation for the period of four years.

Plant Data Used

The data used for the analysis of the air hose component of a mobile air compressor was obtained from Ebocha Oil Centre (EOC), Obrikom Gas Plant. The Compressor model is HC-5320284 12 Volt DC Portable Air Compressor. The collected data from the gas plant was simulated using Microsoft Excel value-based analysis.

Methods

Reliability Tools and Techniques Methodology

The approach of Monte Carlo is worldly acceptable because of it simulation value is close to the experimental determine value as revealed.

Using Existing Concepts

The models for used for the calculation and the determination of the parameters are described below:

Mean Time Between Failure (MTBF)

The mean time between failures (MTBF) for air hose is given as:

$$(MTBF) = \frac{Operating\ time\ (OT)}{Number\ of\ failures\ (NF)} \quad (1)$$

Failure Rate

The failure rate of the air hose component of mobile air compressor was calculated using equation (2)

$$FR = \frac{1}{MTBF} = \frac{1}{OT/_{NF}} = \frac{OT}{NF} \quad (2)$$

Reliability Model

The reliability of the air hose component of mobile air compressor was calculated using equation (3)

$$CCR = e^{-}\left(\frac{1}{MTBF}\right)xt \quad (3)$$

Unreliability Model

The unreliability of the air hose component of mobile air compressor was calculated using equation (4)

$$UM = 1 - e^{-}\left(\frac{1}{MTBF}\right)T\ xt \quad (4)$$

Availability model

The failure rate of the air hose component of mobile air compress was calculated using equation (5)

$$CCAV = \frac{Mean\ Time\ between\ Failure - Lost\ Time\ Per\ Year}{Mean\ Time\ between\ Failure} \quad (5)$$

Failures of Air Hose Compressor Component of Mobile Air Compressor Sampled

The application of Monte Carlo Reliability concepts was applied as the investigation covers a period of 2nd march, 2016 to 31st October, 2019 and the parameters of interest were evaluated as presented in this research.

3. RESULTS AND DISCUSSION

The result obtained in this investigation was in (Table 1) (Figure 1, 2). As in Figure 1, the significance of the air lose component of the mobile air compressor studied for four years. Decrease in the reliability was observed with increase in study period (Time). Reliability value was high at the initial year of installation and latter decrease with increase in operating utilization. The calculation of the reliability value and other parameters are in (Table 1) and increase and decrease was observed in some of the coefficients and functional parameters. The decrease in the reliability of the air hose can be improved by constant maintenance of the unit as well as operating the mobile air compressor in accordance to the design and operation ethics.

Table 1 Results of Reliability Parameters for the Air hose

Parameters	Period (Year)			
	1	2	3	4
Uptime (UT) hrs/week	2976	2784	2592	2352
Study Interval (SI) (hrs)	8760	8760	8760	8760
Downtime (DT) (hrs)	68	72	75	79
Meantime Between Failure (MTBF) (hrs)	496	397.7	324	235.2
Failure Rate (FR)	0.000684	0.000799	0.000913	0.00114
Reliability (R)	0.130 (13.0%)	0.108 (10.8%)	0.093 (9.3%)	0.068 (6.8%)
Unreliability (UR)	0.870	0.892	0.907	0.932
Availability (A)	0.9776	0.9747	0.9718	0.9675
Unavailability (UA)	0.0224	0.0253	0.0289	0.0325

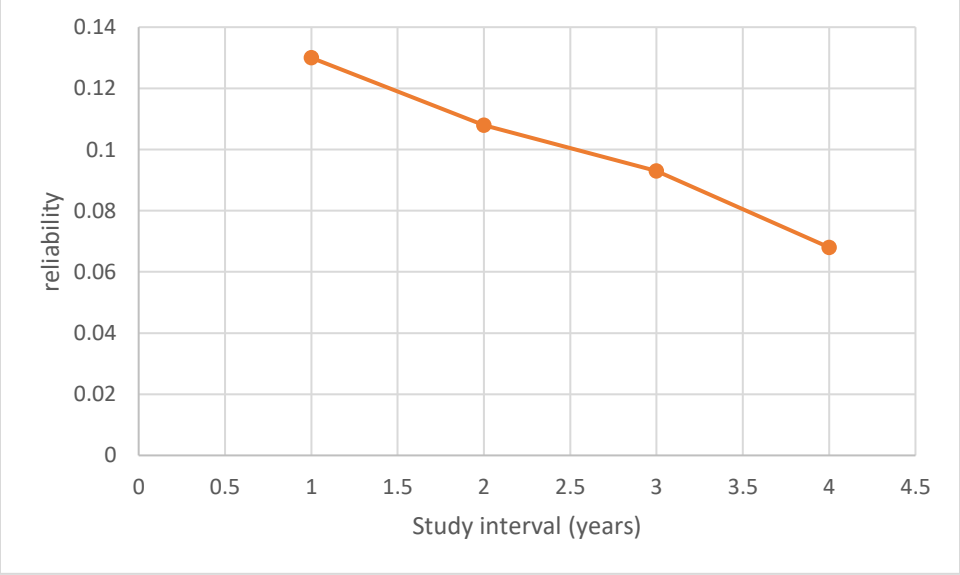

Figure 1 Reliability Analysis of the Air hose for a 4 Years Period

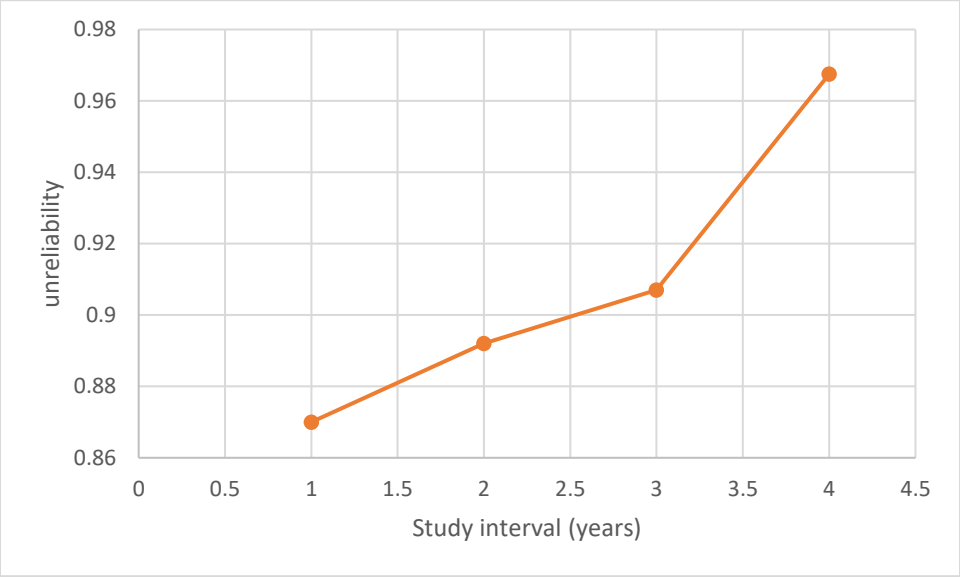

Figure 2 Unreliability Analysis of the Air hose for a 4 Years Period

Figure 2 shows the significance of unreliability behaviors of the air hose when adequate maintenance is not done in accordance to the manufactural specification. Increase in unreliability of the air hose was experienced and this can be integrated to the fact of mobile air compressor in the most gas plant are not ruined in the appropriate manner to save-guide the service life of the air hose. This will increase the cost of unreliability as well as the downtime and production activity will be low, if adequate measures are not introduced to check the cause of the failures of air hose and precautions put in place to reduce the menace.

4. CONCLUSION

The following conclusion was projected from this investigation.

The application of reliability analysis on the mobile air compressor has given a profound knowledge of failure rates of the component of the air hose of the compressor and the period of time the component should be replaced.

The research revealed that the reliability of the air hose decreases with the increase the period of utilization the more the cost of unreliability increases as well.

The downtime for repair of air hose was observed to have increased due to increase in maintenance period which was attributed to increase in air hose failure.

This investigation is projected to create awareness on the air hose mitigation on production as well as increase in the running cost of the facility, if adequate precautions are not taken during turnaround maintenance of a gas plant.

Informed consent

Not applicable.

Ethical approval

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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